THE SCHOOLMASTER's GENERAL ASSISTANT.

VOL. II.

Containing above a hundred curious Discoveries in ARITHMETIC, by which all the Rules are performed in a short and elegant Manner, the SOLUTIONS being generally given in half the Time and Work requisite by the common Rules.

Also EASY RULES for calculating the most useful Cases of Trade, IN MIND, more expeditiously than the best Accomptants can with Pen and Ink, by the *common Rules*.

The Whole delivered in a plain and easy Manner.

See the TABLE *of* CONTENTS.

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Master of the Academy in *Silver-Street*, *Golden-Square*.

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PREFACE.

IN this Second Volume I have endeavoured to ſuit the Taſte of both the Man of Buſineſs, and the ingenious Student, and hope I have not given juſt Cauſe to either to imprecate Vengeance on the Author for trepanning his Caſh, and fraudulently involving him in the vaſt Expence of a beloved HALF CROWN! Since in this ſmall Compaſs he will at one View find, not only a great Variety of Improvements never before publiſhed, but alſo all that is curious or uſeful in the beſt Authors. For, in my Opinion, to publiſh a Man's own Improvements only, and neglect or ſlight thoſe of others, equally valuable, indicates a very high Degree of Pride, and very little Regard to the Reader, who is ſtill left under the Neceſſity of purchaſing and reading over many Volumes, for what ſhould have been comprifed in the laſt Perfor-

mance: Not that I think any Writer ſhould take the Liberty of rifling a well-wrote Book, ſo as to hurt the Author, or the Bookſeller; but with ſome Particulars we may make free, without Prejudice to either, if at the ſame time we have Honeſty enough to acknowledge from whence they are taken. Yet I am perſuaded, that, notwithſtanding all my Care, there will lie two grand Impediments in the Way of this Compendium: The firſt and principal is, that few are curious in theſe Matters (although, after a moderate Knowledge of Letters and Writing, Arithmetic is, indiſputably, the moſt uſeful Part of human Learning) the Generality of Parents being content with their Childrens Abilities in Figures, when they can perform a few ſimple Caſes in Addition and Subtraction, or at moſt Multiplication and Diviſion, they commonly hurrying them away from School, as thoroughly qualified in the neceſſary Parts (whether intended for Trades or the Univerſity) at the very Time they are only prepared for entering into thoſe Rules which can be of any material Utility to them, either in Trade or the Calculation of common domeſtic Affairs. The Conſequence of which is, that you may often ſee a grave Judge on the Bench, and a ſmart Lawyer at the Bar, in the midſt of his moſt florid and elegant Harangue, pitifully puzzled and put to Silence, when an impertinent arithmetical Calculation intrudes itſelf into the Caſe before them: And does not that Merchant (or Gentleman) who is incapable of examining his own Affairs (as too many are) leave it very much in the Power of his Clerk (or

Steward) to defraud him, and greatly retard his Succeſs in the World? If we deſcend yet lower, are not the Heads of Families liable to be impoſed on by their Servants; and every Perſon (unſkilled in Figures) in danger of being a Loſer by every Knave he deals with? In fact, he who is content with his Knowledge of Figures before he underſtands the RULE OF THREE DIRECT, PRACTICE, and INTEREST, has but very little Advantage of him, who is totally ignorant of this noble and moſt uſeful Science; ſince, what little he is capable of, will generally be performed with great Labour, Difficulty and Uncertainty. And yet, how many inconſiderate Parents ſend their Children to an improper Maſter, only becauſe he is a Relation, an Acquaintance, a Cuſtomer, or (O Shame and Ignorance!) becauſe he teaches a trifle cheaper than a Man properly qualified? And yet never reflect, that they are all the while throwing away their Money, and, what is much more conſiderable, and never to be recovered, their Child's invaluable Time! And very poſſibly have thereby prevented him from becoming a fortunate, and a happy Man, a ſeaſonable Support to their old Age, and an Honour to his Country!

And how many, even where both Life and Property are concerned, are more aſſiduous to be thought qualified, than to be ſo in reality, when, perhaps, half the Pains they take to paſs themſelves for what they are not, would make them what they ought to be? I mean Sea-faring Gentlemen

professing the Art of Navigation, who are too often content with a slight superficial Knowledge of that, upon which their future Fortunes, their own Lives, and the Lives of many innocent Persons committed to their Charge, intirely depend; and generally seek no more than what will barely pass Examination (which is often a mere trifle) while others are advanced by Interest, or a favourable Recommendation, without any Examination at all. Nay, many gay young Gentlemen, who are in haste to be finished without the Trouble of thinking, seem rather afraid of knowing too much, than of knowing too little; and are more solicitous to know who teaches cheapest, and dispatches a Gentleman quickest, than who teaches best.

For this Freedom of Speech I hope to be excused, since those whom it suits not, cannot be offended; and to the other Part, it is intended rather as a cautionary Admonition, than as a Reflection.

The second probable Impediment is, that many Persons who are tolerably versed in the common Rules, as they are commonly handled, may possibly expect to see all the Advantages of these Contractions before they are thoroughly acquainted with the Rules, and expert in the Practice; which, though very unreasonable, is often the Case, People frequently exclaiming against the Rule, while the Defect is in themselves. For it must be allowed, that those Methods which are attended with much Difficulty in the Application, though shorter

in

in the Work, are not to be preferred to thoſe which are leſs complex, with a little more Labour in the Execution. But no Man can be a competent Judge on which Side the Advantage lies, but he who is thoroughly ſkilled and equally expert in both Rules. And to ſuch I ſhall willingly ſubmit the Trial of my Book, ſince I am certain (from Experience) that they will find theſe as eaſily applied as the common Rules, and the Solutions generally given in half the Time and Work.

It will very reaſonably be expected by the Subſcribers, that I ſhould ſhew ſome ſatisfactory Cauſe for omitting the mathematical Part in this Volume, mentioned in my Propoſals: My Reaſon then is, that I find thoſe Books which contain leaſt, generally ſell beſt, and the Charge of Printing obliges me to have ſome Regard to this Point; and therefore I know not how what I have here done (though I have omitted theſe abſtruſer Parts) may be accepted; for it is well known that thoſe Gentlemen who have never moved one Step out of the common Cart-road, but have taken a great deal of Pains (ſweating and tugging till their poor Heads ache) to explain to the Public what was well known to all moderately converſant in theſe Matters, long before they commenced Authors, and carefully handed down to us by diligent Copiers and Plagiariſts, have beſt ſucceeded, becauſe their Ware ſuits every common Cuſtomer, while thoſe Books which contain any curious or uſeful Improvements, being neceſſarily attended with a little more Difficulty, and therefore regarded only by the Ingenious and Com-

petent (who are perhaps not one in a hundred) lie moulding on the Bookseller's Shelves, till he, poor Man! (who regards only the Gain) loses all Patience, and cursing his own foolish Head for suffering that Blockhead (the Author) to impose such Trash upon him, throws the useless Lumber out of his Shop, or sells it for waste Paper, till by a regular Series of Promotions it at length arrives to the Honour of manuring my Lord *Littlewit*'s Garden, lighting the important Pipe of some grave leathern Statesman *, or perhaps serves for a Covering to some of those more valuable (that is, more saleable) Books; and thereby prevents the soil'd Finger of Sir *Philomath Clumsey* from cruelly spoiling the tender, helpless Offspring of an innocent, harmless Author: However, if I have omitted the mathematical Part proposed, I have introduced other Things more generally useful, and the Price is in Proportion.

N. B. *Those Articles marked thus +, in the Table of Contents, being chiefly Matters of Curiosity, the trading Accomptant may omit them; all the rest, (except a few Things in Multiplication and Division, applicable only to particular Cases) he will find of general Use in Business.*

* A Cobler.

CON-

CONTENTS

OF THE

SECOND VOLUME.

DIVISION.

RULE

3

RULE OF THREE.

PRACTICE.

48

72

SIMPLE INTEREST.

ALLIGATION.

*89

N. B. *In the Rule, Art.* 101. *page* 172. *it is said, that if the left-hand Figure of the Dividend be added to the whole Number under the left-hand Vinculum, the Sum, excluding the first Figure thereof, will be so many Figures of the Quote; but this is to be limited by the latter Part of the Rule, where you are directed to proceed only till you have got a Quote-figure under the Unit's Place of the Dividend, (which will sometimes happen before you have wrote down all the Figures of the Sum, exclusive of the first) for then you have obtained all the Figures of the Quote: hence it is plain that there will be exactly as many Places in the Quote, as there are Places more one in the Dividend out of the left-hand Vinculum.*

Ex. Divide 8764735187625 by 9999999.
Answer 876473 Quote.

6064098 Remainder.

ARITHMETIC.

I.

ADDITION,

Perform'd by Subtraction.

RULE. Subtract any one of the given Numbers from an Unit, with as many o's annexed as there are Places in said given Number, and from the Remainder subtract another of the given Numbers; and again from the last Remainder subtract another of the given Numbers, and so continue, till all the given Numbers are used as Subtractors. But, when any Remainder is less than the next Subtractor, you must prefix a sufficient Number of 9's to that Remainder; and then annexing as many o's to the assumed Subtrahend,

trahend,

trahend, as you have prefixed 9's to the Remainders, call this Number your complete aſſumed Subtrahend: Then from your complete aſſumed Subtrahend, ſubtract the laſt Remainder, this Remainder is the total Sum ſought.

Example. Having bought 98 ℔. and 999 ℔. and 87 ℔. and 98734 ℔. of Tobacco, 'tis requir'd to find the total Weight by Subtraction only.

Aſſum. Sub. = 100
—98
9902 Rem.
—999
8903 Rem.
—87
98816 Rem.
—98734
...82 laſt Remainder.

100000 Comp. Aſſ. Sub.
—82 laſt Remainder.
Anſ. 99918 Total ſought.

2.

SUBTRACTION,

Perform'd by Addition.

Rule. When the upper Figure is the greater, find how much you muſt add to the under Figure, to make it equal to the upper, ſo much put down: When the under exceeds, find how much muſt be added thereto to make it equal to 10, ſo much add to the upper Figure; put this Sum down, and carry 1 to the next under Figure, and ſo proceed.

3.

To ſubtract ſeveral Sums at once, without putting down the Sum of the Subtractors.

Rule. Subtract the Sum of each perpendicular Column (as you add) from the correſponding Figure in the Subtrahend, and carry 1 for every 10 in the Subtraction, rejecting the Tens in the Addition.

Example. From 59638570

$$\text{Take}\begin{cases}426830\\260735\\29067\end{cases}$$

Anſwer 58921938 Remainder.

Subtraction may alſo be perform'd by taking the leſſer Figure in either Line (when there are but two Lines) from the greater in the other; but theſe being Matters of Speculation only, I ſhall not inſiſt upon them, that I may have the more room to explain the uſeful Parts.

4.

MULTILPICATION,

Perform'd by Diviſion.

Rule. Take the reciprocal Decimal of the leſſer Factor for a Diviſor to the other Factor, the Quotient is the Product ſought.

Ex. Multiply 467898037568 by 125.
Rec. Dec. ,...8)————————
Anſwer 5848729696000 the Prod. ſought.

5.

To multiply by any whole (or decimal) Number, uſing no more than one Figure of the given Multiplier.

Rule. Multiply the Multiplicand by any (aſſign'd) Figure of the given Multiplier, then multiply the whole Multiplicand by the Difference of this Figure, and the next neareſt (in ſimple Value) thereto in the Multiplier; which Product add to, or ſubtract from, the former Product, according as the latter Digit is greater or leſs than the former, and put down this Sum or Remainder, in its proper Place, *viz.* the right-hand Figure thereof under the Place of the multiplying Digit; and ſo proceed through all the Places of the given Multiplier.

Ex-

Example. 'Tis required to multiply 46789837568 by 65879, uſing only the Figure 9 thereof as a Multiplier.

$$
\begin{array}{rl}
46789837568 & = a \\
\cdots\cdot 9 & \\
\hline
421108538112. & = b \text{ - - - - - - - - - - } 9a \\
374318700544.. & = c = b - a \text{ - - } = 8.. \\
.327528862976. & = d = c - a \text{ - - - - } = 7. \\
280739025408.... & = e = d - a \text{ - - } = 6.... \\
.233949187840... & = e - a \text{ - - - - } = 5... \\
\hline
3082467709142272 & = \text{Prod. ſought} = 65879a
\end{array}
$$

In this Example we have the Product by all the Figures after the firſt, by Subtraction only; and we might have obtain'd it by Addition only, if we had begun with the 5.

6.

To give the Product of any Multiplication, without multiplying by any Figure of the given Multiplier.

Rule 1. Subtract your given Multiplier from the next greater round Number; and having multiplied your given Multiplicand by this Difference, ſubtract the Product from the Product of your round Number and Multiplicand, the Remainder is the Product ſought.

Rule 2. Subtract your given Multiplier from 1 with as many 0's annext as there are Places in the Multiplier; then having multiplied your given Multiplicand by this Remainder, ſubtract the Product from your Multiplicand with as many 0's annext (or ſuppos'd annexed) as there are Places in the given Multiplier, this Remainder is the Product ſought.

Example. Multiply 46789837568 by 599997, or by 999995.

By Rule 1.	46789837568	600000
	×3	—599997
	Take 140369512704	Dif. 3
	from 28073902540800000	Prod. by 600000.
	Anſwer 28073762171287296	Product ſought.

By Rule 2.	46789837568 000000	
1000000	×5	
—999995	—233949187840	
Dif. 5	46789603618812160	Product.

7.

To multiply by a Number conſiſting of any aſſign'd Number of Places, giving only the Product, by dividing by a ſingle Integer.

Caſe 1. *To multiply by any given Line of 3's (as 3333, &c.) with the Fraction $\frac{1}{3}$ annexed, giving only the Product.*

Rule. To your given Multiplicand annex as many 0's as there are Places in the integral Part of your Multiplier, one third of this increaſed Multiplicand is the Product ſought. But, if you ſeek the Product by the whole Number only, then from the former Product, you muſt ſubtract $\frac{1}{3}$ of the given Multiplicand, the Remainder is the Product ſought.

Caſe

Caſe 2. *To multiply by any Number having* 1 *in the higheſt Place, the reſt being* 6's *with* $\frac{4}{6}$ *annexed* (*as* 16666$\frac{2}{3}$) *giving only the Product.*

Rule. Annex as many 0's as there are Places in the integral Part, and divide by 6; but for the Product by the whole Number, ſubtract $\frac{4}{6}$ of the given Multiplicand.

Caſe 3. *To multiply by a Number of this Order,* 90909$\frac{1}{11}$, or 9090$\frac{10}{11}$, *&c.*

Rule. Annex one 0 more than the Number of integral Places, and divide by 11; but for the whole Number, ſubtract $\frac{1}{11}$ in the former Example, and $\frac{10}{11}$ in the latter.

Caſe 4. *To multiply by any Number in this Form* 8333$\frac{1}{3}$, *giving only the Product.*

Rule. Annex one 0 more than there are Places in the integral Part, and divide by 12; for the Product by the whole Number, from the former Product ſubtract $\frac{4}{12}$ of the given Multiplicand.

Caſe 5. *For the Product by* 1111$\frac{1}{9}$, *&c.*

Rule. Annex as many 0's as there are integral Places, and divide by 9; for the Product by the whole Number, ſubtract $\frac{1}{9}$ of the Multiplicand.

Ex. 'Tis requir'd to multiply 46789837568 by 142857$\frac{1}{7}$, giving only the Product.

To do this, you need only annex ſix 0's to the given Multiplicand, and divide by 7, the Quote is the Product ſought.

7) 46789837568000000

Anſwer 6684262509714285$\frac{5}{7}$ Product ſought.

Again, if the Product by 142857 only were requir'd, you muſt ſubtract $\frac{1}{7}$ of the given Multiplicand from the above Product.

Ex. $7\,)\,46789837568 + 5$

$$6684262509'714285\tfrac{5}{7}$$
$$-\,6684262509\tfrac{5}{7} = \tfrac{1}{7}$$

Anſwer 6684255825451776 Product ſought.

I have here placed the Subtractor in its proper Place, to make the Operation clear to the Learner; but it may be as eaſily ſubtracted as it ſtands in the firſt Product, and then there will be one Line fewer in the Work.

And in like Manner may the Product by any circulating Numbers of theſe Forms (whether whole or decimal) be obtain'd.

8.

To give the Product by any Number of 9's by Subtraction.

Rule. To the given Multiplicand annex as many 0's as there are 9's in the Multiplier; then from this increaſed Multiplicand ſubtract the given Multiplicand, the Remainder is the Product ſought.

Ex. Multiply 46789837568 by 999999.

$$46789837568000000$$
$$-\,46789837568$$

Anſwer 46789790778162432 Product ſought.

Note, *The Work is as eaſily perform'd, by giving only the Product; and the Rule is as applicable to Decimals as whole Numbers.*

9.

9.

To multiply by any Number, whose right-hand Figure is any Digit, the rest being 9's, giving only the Product.

Rule. Annex to the Multiplicand, as many 0's as there are Places in the given Multiplier; then from this Sum subtract (as you multiply) the Product of the given Multiplicand by the Difference between the right-hand Figure (of the Multiplier) and 10, this Remainder is the Product sought.

Ex. Multiply the above Multiplicand by 999996.

	4678983756800000	10	
	— × 4	— 6	
Answ. the Prod. is	4678965040864972 8	4	Dif.

Hence, we have these Contractions, *viz.*

To multiply by any Numbers in the following Forms, giving only one Line and the Product, viz.

Forms, 333, &c. [1] 1199988, &c. [2] 1111, &c. [3] 90909, &c. [4]

For the first Case, take $\frac{1}{3}$ of the Product by as many 9's as there are 3's in the given Multiplier.

For the 2d Case. Multiply by as many 9's less two, as there are Places in the given Multiplier, and take 12 times this Product.

For the 3d Case. Multiply by as many 9's as there are 1's given, and take $\frac{1}{9}$ of this Product.

For the 4th Case. Multiply by as many 9's more one, as there are Places in the given Multiplier, and take $\frac{1}{11}$ of the Product.

Example. Multiply the foresaid Multplicand by 119999988.

—467898375 68.......
467898328890162432
$\times$ 12

Answ. the Product sought 56147799466 81949184

10.

To multiply any Number of 9's by the same Number, by Inspection.

Rule. Put down as many 9's less one, as there are 9's in the given Number, and one 8; then put down as many 0's as you have put down 9's, then 1.

Example. Requir'd the Square of 999999.

Answer 999998000001 Product sought.

11.

To multiply any Line of 9's by any one of the nine Digits, by Inspection.

Rule. To the right of the given Multiplicand, excluding one 9, put down the Excess of 10 above the multiplying Digit; and to the left put down the Excess of 9 above the right-hand Figure, thus found.

Example. Multiply 999999 by 97.

$\bar{6}99999\bar{3}$ $\quad$ $10-7=\bar{3}$ and $9-3=\bar{6}$
$\bar{8}99999\bar{1}$ $\quad$ $10-9=\bar{1}$ and $9-1=\bar{8}$

Answer 96999903 Product.

12.

12.

To multiply by any Line of 1's (*as* 1111, &c.) *giving only the Product, by Addition.*

Rule. Put down the right-hand Figure of the Multiplicand under its Place there; then put down the Sum of the two firſt Figures of the Multiplicand (as in common Addition, *viz.* carrying the Tens, and putting down the reſt) then the Sum of the three firſt Figures, and ſo on till you have taken into one Sum as many Figures of the Multiplicand as there are Places in the given Multiplier; then reject the laſt right-hand Figure, and take in the next left-hand Figure of the Multiplicand (ſtill adding at every Step as many Figures as there are Places in the Multiplier) till you have taken in the higheſt Figure of the Multiplicand; after which, continue adding all the Figures in the laſt Step, except the right-hand Figure thereof (*viz.* omit a Figure at every Step) till you have taken in the higheſt Figure of the Multiplicand alone, which finiſhes the Work.

Caſe 2d. But obſerve, that if there are more Places in the Multiplier than in the Multiplicand, you muſt (after you have taken in the higheſt Place of your Multiplicand) continue putting down the Sum of your whole Multiplicand till you have got a Product-figure under the higheſt Place of your Multiplier, and then proceed as in the firſt Caſe, putting down all at every Step except the right-hand Figure of the preceding Step, till you have taken in the higheſt Figure of the Multiplicand alone.

Caſe 3d. When there are o's intercepted, then proceed as before for the Product by the 1's to the right of the o's, till you have got a Product-figure under the firſt of the 1's to the left of the o's; then multiply by the left-hand 1's (as before directed) and add the Product to the Product by the right-hand 1's, ſtill keeping as many Places in the Multiplicand between the Products (or Sums) as there are o's in the

Multiplier, till you have finiſhed the Product by the right-hand 1's; after which finiſh the Multiplication by the left-hand 1's only, and the Work is done.

Ex. to Caſe 1. Multiply 46789837568 by 1111.

....

Product ſought 51983509538048

Ex. to Caſe 2d. Multiply 4237 by 111111.

......

Product ſought 470777307

Caſe 1. Firſt 8, then 6 + 8, then 5 + 6 + 8, then 7 + 5 + 6 + 8, then 3 + 7 + 5 + 6, &c. adding 1 to every Step for every Ten in the Sum at the preceding Step.

The beſt Explanation of Caſe 3d. will be to compare the contracted Work with the Work by the common Rule, as they ſtand below.

Example. Multiply the above Multiplicand by 111100011 in one Line.

```
       46789837568
         111100011
       -----------
       46789837568
      46789837568.
    46789837568.....
   46789837568......
  46789837568.......
 46789837568........
--------------------
5198351468493013248 Prod. by the common Rule.
--------------------
       46789837568 ⎫
         ....000.. ⎬ by the Contraction.
------------------ ⎪
5198351468493013248⎭
```

Caſe 4. Alſo, it is evident, that if we multiply the laſt Product by 4, we ſhall have the Product of the

the given Multiplicand by 444400044 (because 11110011 × 4 = 444400044); and if we multiply the Product in the first Case by 6, we shall have the Product by 6666.

And thus may any whole Number or Decimal be multiplied by a repeting Digit, giving only one Line besides the Product, or by giving only the Product, if we multiply every Product-figure as it is found, by the repeting Digit.

Case 5. Some other Examples.

9837568	9837568	9837568
×1114	×4111	1141
39350272	1091970048	10929538048 ×1111
1091970048	39350272	29512704. × 3
10959050752 -	40442242048 -	11224665088

Though I have here given two Lines in the Work (to explain the Operation) yet one Line will be sufficient, if to the Product by the 1's we add the Product by the Digit at every Step, putting down the Sums as they are found.

13.

To give the Product of any Number by any Line of 1's, by Subtraction.

Rule. Proceed as before, till you have got a Product-figure under the highest Place of the given Multiplier; then if the Numbers carried to and from the last Step are equal, the Difference of the highest Figure of the present Step, and lowest of the last added to or subtracted from the Sum at the last Step (according as the former is greater or less than the latter) gives the Sum at the present Step, *&c.* But, if the Numbers carried to and from any Step are unequal, then their Difference must be subtracted from the highest (or left-hand) Figure of the present Step, if the

the Number carried exceeds the Number to be carried, otherwise the Difference must be added; and then find the Difference of the highest Figure of the present Step, and lowest of the preceding Step, and proceed with it as before. And thus proceed, till you have taken in the highest Figure of the Multiplicand: After which proceed thus, *viz.* If the Number to carry from the last Step exceeds the Number carried to it, you must subtract this Difference from the next Figure to the left of the lowest Figure of the last Step, (otherwise add) and then subtract this Remainder (or Sum) from the Sum at the last Step; and at every succeeding Step, add the Difference of the Numbers carried to and from the preceding Step, to the next Figure to the left of the last Subtractor; which Sum subtracted from the Sum at the last Step leaves the Sum at the present Step; and thus proceed till you have us'd that Figure of the Multiplicand next to the highest as a Subtractor, which finishes the Work.

Examp. 'Tis requir'd to multiply 46789837568 by 1111 by Subtraction, giving only the Product.

l k i h g f e d c b a
46789837568
Answer 51983509538048 Product sought.

EXPLANATION.

$\overset{a}{8} \mid \overset{b}{6}+\overset{a}{8}=14 \mid 1+\overset{c}{5}+14=20 \mid 1+\overset{d}{7}+20=28 \mid$
$\overset{a}{8}-\overset{e}{3}=5$, and $-5+28=23 \mid \overset{f}{8}-\overset{b}{6}=2$, and
$2+23=25 \mid \overset{g}{9}-\overset{c}{5}=4$, $4+25=29 \mid \overset{h}{8}-\overset{d}{7}=1$, and
$1+29=30 \mid \overline{1+\overset{i}{7}}-\overset{e}{3}=5$, and $5+30=35 \mid$
$\overset{f}{8}-\overset{k}{6}=2$, and $-2+35=33 \mid \overset{g}{9}-\overset{l}{4}=5$, and
$-5+33=28 \mid \overline{1+\overset{h}{8}}=9$, and $-9+28=19 \mid$
$\overline{1+\overset{i}{7}}=8$, and $-8+19=11 \mid -6+11=5 \mid$ Finis.

14.

14.

To multiply by any Number, viz. *Whole or Decimal, giving only the Product.*

Rule. Put down the Product-figure of the first Figure of the Multiplicand by the first of the Multiplier—To the Product of the second of the Multiplicand by the first of the Multiplier add the Number to carry, and the Product of the first of the Multiplicand by the second of the Multiplier, and carrying for the Tens in the Sum, put down the rest.—To the Product of the third of the Multiplicand by the first of the Multiplier add the Number to carry, and the Product of the second of the Multiplicand by the second of the Multiplier; and the Product of the first of the Multiplicand by the third of the Multiplier, carry the Tens, and put down the rest, and so proceed till you have multiplied the highest of the Multiplicand by the lowest of the Multiplier. Then multiply the last (or highest) of the Multiplicand by the second of the Multiplier, add the Number to carry; and the Product of the last but one of the Multiplicand by the third of the Multiplier, and the Product of the last but two of the Multiplicand by the fourth of the Multiplier, *&c.* —Then to the Product of the last of the Multiplicand by the third of the Multiplier add the Number to carry, and the Product of the last but one of the Multiplicand by the fourth of the Multiplier; and so proceed till you have multiply'd the last of the Multiplicand by the last (or highest) of the Multiplier, which finishes the Work.

Example. Multiply 5321415
By 2354

Product 12526610910

Ex-

EXPLANATION.

$$5 \times 4 = 20 \mid \overline{1 \times 4 + 2} + \overline{5 \times 5} = 31 \mid$$
$$\overline{4 \times 4 + 3} + \overline{1 \times 5} + \overline{5 \times 3} = 39 \mid$$
$$\overline{1 \times 4 + 3} + \overline{4 \times 5} + \overline{1 \times 3} + \overline{5 \times 2} = 40 \mid$$
$$\overline{2 \times 4 + 4} + \overline{1 \times 5} + \overline{4 \times 3} + \overline{1 \times 2} = 31 \mid$$
$$\overline{3 \times 4 + 3} + \overline{2 \times 5} + \overline{1 \times 3} + \overline{4 \times 2} = 36 \mid$$
$$\overline{5 \times 4 + 3} + \overline{3 \times 5} + \overline{2 \times 3} + \overline{1 \times 2} = 46 \mid$$
$$\overline{5 \times 5 + 4} + \overline{3 \times 3} + \overline{2 \times 2} = 42 \mid \overline{5 \times 3 + 4} + \overline{3 \times 2} = 25 \mid$$
$$\overline{5 \times 2 + 2} = 12 \mid .$$

By much Practice in this Method, a good Accomptant may become expert and ready in the Application of this Rule; but till then he will find it more troublesome and tedious than the common Rule.

15.

A general Contraction in Multiplication.

When any Figure, or Number of Figures in the Multiplier, is a Multiple or aliquot Part of some other Figure or Figures in the Multiplier, you may take a like Multiple or aliquot Part of the Product by the one, for the Product by the other; but observe to place the first Figure of this Product under the first (or right-hand) Figure of the present multiplying Figures.

Ex. Multiply $4678983756 8 = a$

By 19249696248

$$
\begin{array}{rl}
374318700544 = b & \text{- - - - - - - - -} = 8a \\
1122956101632. = c = 3b & \text{- - - - - -} \; 240a \\
4491824406528\ldots = d = 4c & \text{- - -} = 96000a \\
\hline
4503428286244864 = e = b + c + d & = 96248a \\
9006856572489728\ldots\ldots = 2e & = 19249600000a \\
\hline
\text{P.}\; 90069016067725904 4864 & = 19249696248a
\end{array}
$$

This is sufficiently explain'd in the Margin; where the Letters represent their opposite Lines.

Here we have the full Work in five Lines (besides the Answer) which would have required eleven Lines by the common Rules. Nor is there any more Difficulty in finding the Product of several Figures (at once) by this Method, than in finding the Product by a single Figure by the common Rule.

16.

To contract Multiplication when there are many Decimals in either Factor.

Rule. Invert the Multiplier (or decimal Factor) and set the Unit's Place of the Multiplier under that Figure of the Multiplicand, whose decimal Place you intend to keep in the Product. Then in multiplying, always begin (every Product-line) with that Figure of the Multiplicand which stands directly over your multiplying Figure, and place the several Product-lines even at the right Hand. But observe to add to the first Figure of every Product-line, the Number to be carried from the Product of the two next right-hand Figures of the Multiplicand by the multiplying Figure. Note also, that if the Product of the right-hand Figure of these two omitted Figures has more than 5 over the Tens (or under Ten) then add one more to the Number to be carried for the Tens.

Example. Multiply 467,89837568 by ,142857, giving 5 Decimals in the Product.

$$
\begin{array}{r l}
467{,}898\overline{37568} & \text{rejected.} \\
\times\ 758241{,}0 & \\
\hline
4678983 & \\
1871593 & \\
93580 & \\
37432 & \\
2340 & \\
327 & \\
\hline
66{,}84255 & \text{Product sought.}
\end{array}
$$

which is the exact Product to the fifth decimal Place, as requir'd; hence this contracted Work is sufficiently exact, and saves forty-eight Figures in the Work.

17.

To give the Product of any Number by a vulgar Fraction, without multiplying by the Numerator, as the common Rule directs.

Rule. Divide the given Multiplicand by the Denominator of your Multiplier, this Quotient multiply by the Difference of the Numerator and Denominator of your multiplying Fraction, which Product subtract from your given Multiplicand, if your Multiplier be a proper Fraction, otherwise add; the Difference or Sum is the Product sought.

Exam. Multiply 34756516,3 by $\frac{4355}{4367}$.

4367) 34756516,3 (7958,9 Quote.
— 4355 — 95506,8 = Product by × 12 Difference.
Diff. 12 ——————

Answer 346610095 Product sought.

Exam.

Exam. 2. Mulptiply 569376 by $\frac{8999}{9000}$.

9) 569'376
— 63,264 Quote.

'Anſwer 569312,736 Product ſought.

In the firſt Example we ſave 50 Figures.

And if the ſecond be wrought by the common Rule, 'twill require nine times the Number of Figures requiſite by this Rule.

18.

To multiply different Denominations by a Digit with 0'*s annexed, giving only the Product.*

Rule. Multiply the given Denominations ſeverally by the given Digit, and to each Denomination of the Product (wrote down ſeparately) annex as many 0's as were given in the Multiplier.

The Work.

	l.	*s.*	*d.*	
Ex. Multiply	376 -	15 - - -	9	by 8000
			×8	
Anſwer	3008000	12000|0	72000	Pr. ſought.
	+ 6300	+600|0		

Alſo 3014300 *l.* the Pr. in the prop. Expreſſion.

And certainly this is much ſhorter than to reduce the given Sum to Pence, and again (after multiplying by 8000) reduce the Product to Pounds, &c.

19.

To multiply different Denominatious by any whole Number, without any Reduction.

Rule. Multiply as in whole Numbers, esteeming every Denomination in the Multiplicand an independant Multiplicand, and consequently keeping the Denominations in the Product separate, and under their Correspondents in the Multiplicand.

Ex. Having bought 357 Houses, at 263*l.* 15*s.* 10*d.* *per* House, one with another, what is the Amount?

	l.	*s.*	*d.*
	263 - - -	15 - - -	10
	1841	105	70
	1315.	75.	50.
	789..	45..	30..
	93891	5355	12) 3570
	+282	+297	6 *d.*
		565|2	
Answer	94173 *l.*	12 *s.*	6 *d.*

Hence all Questions of the Rule of Three may be wrought without reducing either the second or third Term.

20.

To give the total Value of several unequal (or equal) Numbers of Things, sold at different Rates, at once; viz. without finding the particular Amounts.

Rule. Reduce the unequal Numbers to equal Numbers (or one common Number) increasing or decreasing their Rates (inversely) as you have decreased or increased their respective Numbers; and then find the total Value of the common Number (to which they are reduced) at the Rate of the Sum of the reduced Rates, this will be the total Amount sought.

Ex. Bought 50 Hogs at 2*l.* 6*s.* each; and 20 Sheep at 2*l.* 3*s.* 4*d.* and 100 Bullocks at 9*l.* 16*s.* 6*d.* each; and 80 Horses at 8*l.* 16*s.* 3*d.* each; requir'd the total Amount, without finding the particular Amounts.

	l.	*s.*	*d.*			Or thus, *l.*	*s.*	*d.*	
100 Hogs at —	1	3	0	$\frac{1}{2}$	com.Num.80	1	8	9	
100 Sheep at—	0	8	8	$\frac{1}{5}$		0	10	10	
100 Bullocks at	9	16	6	1		12	5	$7\frac{1}{2}$	
100 Horses at—	7	1	0	$\frac{4}{5}$		8	16	3	
	1800					230	10	55	P. by 10
	+ 45	16	8					× 8	
Ans.	1845	16	8		Ans.	1845	16	8	

And in like manner you may reduce all to the common Numbers 50 or 20; and here the Work is given in about one fourth Part of the Number of Figures requisite by the common Rules.

21.

To reduce Pence into Shillings, without dividing by 12.

Rule. From one tenth of the given Number of Pence, ſubtract one ſixth of this one tenth, the Remainder is the Anſwer.

Ex. In 436977 Pence, how many Shillings?

Vulgarly.	Decimally.
6) $43697\frac{7}{10}$	6) 43697,7
— $7282\frac{19}{20}$	7282,95
Anſwer $36414\ \frac{3}{4}$ Shil.	Anſ. 36414,75 Shil.

22.

To reduce Shillings into Pence, without multiplying by 12.

Rule. To the given Shillings annex 0, and add one fifth of this.

Ex. In $36414\frac{3}{4}$ Shillings, how many Pence?

Vulgarly.	Decimally.
5) $364140\frac{30}{4}$	364147,5
+ $72828\ \frac{6}{4}$	+ 72829,5
Anſwer 436977 Pence.	Anſ. 436977 Pence.

23.

To multiply different Denominations by different Denominations, without reducing either Factor, which may be perform'd, by giving only the Product in many Caſes.

Rule. Subtract the inferior Denominations of each Factor (ſeverally) from an Unit of the higheſt Denomination, and call theſe Remainders the Differences of their reſpective Factors; then to the Product

duct of the whole Number plus 1, multiply'd by the whole Number of the other Factor plus 1, add the Product of the Differences; from this Sum subtract the Sum of the Products made by multiplying the Difference of the one Factor by the whole Number of the other Factor plus 1; this Remainder is the Product sought.

But when the whole Numbers of the Factors are equal, the Rule may be expressed thus; *viz.* 1st. Subtract each Factor from the given whole Number plus 1, and add these Differences. 2d. From the Square of the given whole Number plus 1, subtract the Product made by multiplying the Sum of the Differences by the whole Number plus 1.—3d. To this Remainder add the Product of the Differences, this Sum is the Product sought.

Ex. Admit a Room measures 10 F. 11 I. 9 P. Square, what is the Area of the Floor?

11 whole Number + 1
× 11
—— $\quad 6''$ Sum of the Differences.
$\quad\quad\quad\quad \times 11$
Square $121\ 0'\ 0''$ ——
$\quad -5\ 6 = 66''$ Prod. Sum Dif. by whole. [Num. + 1
———
Answer $\overset{F}{120}\ 6'\ 6''\ 0'''\ 9''''\ (9'''' = 3'' \times 3'' =$ P. of the Diff.

Examp. 2. Multiply 19*l.* 19*s.* $11\frac{3}{4}$*d.* by 19*l.* 19*s.* $11\frac{3}{4}$*d.* in the shortest Manner possible (which is by the above Rule.)

20
× 20
——
400*l.* 0*s.* 0*d.*
$\quad -10\ (= 20l. \times \frac{1}{2}d.)$
———
Answer 399 19 $2\frac{1}{3840}$ $(\frac{1}{4}d. \times \frac{1}{4} \times \frac{1}{240} = \frac{1}{3840}d.)$

Here is the full Work, not a ſingle Figure being omitted. Therefore, to ſhew how much Labour is ſaved by this Rule, (and to ſhew the common Methods of working theſe kind of Queſtions) I ſhall give the Work of this Queſtion by the common Rules.

Thus,

```
      l.  s.  d.                         s.
      19  19  11¾                        20
      20                                 12
     ----                               ----
     399                                240
      12                                  4
     ----                               ----
    4799                                960
       4                                960
   -----                              ------
   19199                              57600
   19199                             8640
  -------                            --------
  172791                             9216(00
 172791
172791
19199
-------------------------  l.   s.   d.
9216 ) 3686016 ( 01 ( 399   19   2 1/3840.
        92121
         91776
          883201
              20
        ---------
  9216 ) 176640(20 ( 19 s.
          84480
           15362
              12
         -------
   9216 ) 184344 ( 2 d.
        24/92160 | 2/7680 | 1/3840
```

Or

Or thus,

	l.	*s.*	*d.*	
	19	19	$11\frac{3}{4}$	
			$\times 10$	
	199	19	$9\frac{1}{2}$	
			$\times 2$	
	399	19	7	
	-19	19	$11\frac{3}{4}$	
				3840
	379	19	$7\frac{1}{4}$	960
$10s. = \frac{1}{2}$ - - - - - =	9	19	$11\frac{7}{8}$	3360
$5s. = \frac{1}{2}$ - - - - - =	4	19	$11\frac{15}{16}$	3600
$4s. = \frac{1}{5}$ - - - - - =	3	19	$11\frac{19}{20}$	3648
$8d. = \frac{1}{6}$ - - - - - =	0	13	$3\frac{119}{120}$	3808
$2d. = \frac{1}{4}$ - - - - - =	0	3	$3\frac{479}{480}$	3832
$1d. = \frac{1}{2}$ - - - - - =	0	1	$7\frac{959}{960}$	3836
$\frac{1}{2}d. = \frac{1}{2}$ - - - - - =	0	0	$9\frac{1919}{1920}$	3838
$\frac{1}{4}d. = \frac{1}{2}$ - - - - - =	0	0	$4\frac{3839}{3840}$	$\frac{3839}{30721}$
	399	19	$2\frac{1}{3840}$	

24.

To multiply Pounds, Shillings, Pence and Farthings by any given Digit with Cyphers annexed, at once, without any Reduction of the given Denominations.

Rule 1. Multiply the Farthings by the given Digit (exclusive of the o's) and carrying the Pence of the Product in mind, put down the odd Farthings remaining (in the Margin, or any where apart).

2.

3

2. Multiply the given Pence by the Digit, and to the Product add the Number (of Pence) carried from the Farthings; then find how many Shillings in these Pence, which Shillings carry in mind, and put down the odd Pence (if any) under the former odd Farthings.

3. Multiply the right-hand Figure of the given Shillings by the Digit, and to the Product add the Number (of Shillings) carried from the Pence; and carrying in mind one for every ten in this Sum, put down the rest under the former odd Pence and Farthings: Then multiply the left-hand (given) Shillings by the Digit, to the Product add the Number carried from the last Product, put down the odd 1 of this Product (if any) to the left of the former Shillings (already put down) and carry half the rest to the Product of the given Pounds by the Digit (multiplied as in common).

4. But, observe to put the right-hand Figure of the Product of the Pounds by the Digit (under the given Pounds) as many Places to the left of the Unit's Place, as the multiplying Digit is to the left of the Unit's Place in the given Multiplier, reserving the vacant Places of the Pounds, for the Pounds, to be brought thither from the marginal Work.

5. Also, observe to place all the Numbers wrote down (*viz.* Farthings, Pence, and Shillings) even at the right-hand. Then to reduce the marginal Work, and fill up the vacant Places in the Product sought, proceed thus, *viz.*

6. Having annexed as many 0's to the Denomination first wrote down in the Margin, as there are Places in the given Multiplier to the right of the multiplying Digit, reduce the Farthings (wrote down in the Margin) to Pence, annexing these Pence to the Pence formerly wrote down, and put the Remainder (if any) in the Place of Farthings.

7. Reduce the Pence to Shillings, annexing these Shillings to the Shillings formerly wrote down, and put the Remainder (if any) in the Place of Pence.

8.

8. Reduce the Shillings to Pounds, and put the remaining Shillings (if any) in the Place of Shillings; and annex the Pounds to the Pounds formerly wrote down in their proper Place.

		l.	s.	d.
Ex. What cost 5000 Acres of Land at		39	18	11¾
per Acre?				
		l. 199	......	

s.	d.	f.	1
18	11	3	
		×5	

		Reduced 2	
Farth.	3 ...	4) 3000	0 f.
Pence	10 ...	12) 10750	10 d.
Shill.	14 ...	2|0) 1489|5	15 s.
		744 l.	

Now transferring these marginal Numbers to the vacant Places of the Product, we have 199744 *l.* 15 *s.* 10 *d.* the Product, or Answer. But there is no need of both these Operations in the Margin (the second alone being sufficient) though I have given both, to explain the Rule. Nor is there any Necessity for the whole Work of the second Operation in the Margin; since the last reduc'd Denominations may be put down in their proper Places in the Product, as they are found. Also the Divisors (4, 12 and 20) being always known, need not be put down; therefore the full Work may stand thus, *viz.*

		l.	s.	d.
3000	Farth.	39	18	11¾
10750	Pence.			
14895	Shill.	199744	15	10 Answer.

EXPLANATION.

5 times 3 *f.* is 15 *f.* (or 3 *d.* 3 *f.*) that is 3 *f.* to put down, and 3 *d.* to carry. — 5 times 11 *d.* is 55 *d.*

3

55 *d.* and 3 *d.* carried is 58 *d.* (or 4 *s.* 10 *d.*) that is, 10 *d.* to put down, and 4 *s.* to carry. 5 times 8 *s.* is 40 *s.* and 4 *s.* carried is 44 *s.* that is 4 *s.* to put down, and 4 to carry. Again, 5 times 1 and 4 carried is 9, then putting down the odd 1 to the left of the 4 already put down, I carry 4 (*viz.* the half of 8) to the Product of the Pounds, which makes 199 (or 199000) Pounds, which I put down in the Place of Pounds. Then for the Margin.

1. 3000 Farthings divided by 4, the Quote 750 *d.* falls to the right of the 10 *d.* formerly put down, and makes the whole 10750 *d.*

2. Then these Pence divided by 12, the Quote 895 *s.* falls to the right of the 14 *s.* formerly put down (the 10 *d.* remaining I directly carry to the Place of Pence in the Product).

3. The (14895) Shillings I divide by 20, the Quote 744 *l.* I place to the right of the 199 formerly put down, and the remaining 15 *s.* I put in the Place of Shillings, which finishes the Work.

And by this Rule may the Product of the second and third Terms, in all Statings of the Rule of Three, be found, and all Cases of Practice wrought, as may be seen in these Rules.

DIVI-

DIVISION.

25.

To perform Division by Multiplication.

Rule. Multiply the Dividend by the reciprocal Decimal of the Divisor, this Product is the Quotient sought.

Ex. Divide 46789837568 by 78125.
,....128 recip. Decimal.

374318700544
5614780050816

Answer 598909,9208704 the Quote sought.

26.

To find the true Remainders at every Step of component Division.

Rule. Multiply each Remainder by all the precedent Divisors (except its own) successively; then to the Sum of these Products add the first Remainder; this Sum is the complete Remainder. And this Rule determines the Remainder at every Step.

Ex.

Ex. Divide 6398 (which call a) by the component Parts of 1512.

$a \div 4$	4	6398 + 2 Remainder.
$a \div 24$	6	$1599 + 3 \times 4 + 2 = 14 =$ 2d Remain.
$a \div 216$	9	$266 + 5 \times 6 \times 4 + 3 \times 4 + 2 = 134 =$ 3d Remainder.
$a \div 1512$	7	$29 + 1 \times 9 \times 6 \times 4 + 5 \times 6 \times 4 + 3 \times 4 + 2 = 350 =$ 4th Rem.
		Qu. 4; and Remainder $= 350$.

Or thus,

4	6398
6	$1599\frac{2}{4}$ = 1st Remainder.
9	$266\frac{14}{24}$ = 2d Remainder.
7	$29\frac{134}{216}$ = 3d Remainder.
	Qu. $4\frac{350}{1512}$ 350 = complete Remainder as before. 1512 = the given Divisor.

Hence, those who understand vulgar Fractions, will easily understand the Reason of the general Rule; for the Remainders in the first Example are found in the same Manner as the Numerators of the Fractions in the latter, so that the Rule saves the Trouble of finding the Denominators, each of which is always equal to the perfect Divisor of that Step to which the Denominator belongs.

Or the complete Remainder may be found thus.

Rule.

Rule. Subtract the Product of the given Divisor by the last (or requir'd) Quote, from the given Dividend, this Remainder is the perfect Remainder.

6398 the given Dividend.
Ex. $1512 \times 4 = 6048$

350 the complete Remainder.

27.

To determine the exact Remainder of any Division, before you begin the Division, or know any Part of the Quote.

Rule. Turn the given Divisor into a (reciprocal) Decimal for a Multiplier, and find the Decimal of the Product; then this Decimal being divided by the Multiplier, the Quote is the Remainder sought.

Ex. Suppose 896783476824 were given to be divided by 625, I desire to assign the Remainder, without performing the Division, or knowing any Part of the integral Quote.

6824
,..16 reciprocal Decimal.

4,9184 Decimal of the Product.

Then

,..16),9184 (574 the Remainder sought.
118
64

0

Hence,

Hence, having determined any Remainder by this Rule, we may assign an infinite Number of Numbers (as quickly as they can be wrote down) which being divided by the same Divisor, will leave the same Remainder. And thus may a Master prove his Scholar's Division-Sums, without taking the Trouble to examine the Work: Also, he may set all his Scholars (who are learning Division) different Sums, and yet the Proof of one will be a Proof of all: And in some Cases the Remainders only are useful, as in determining Leap-Year, &c.

28.

To divide by any assign'd Number of (circulating) Figures, with a Fraction annexed, giving only the Quote.

Rule. See Multiplication of Circulates (Page 5. Art. 7.) And whatever Number was a Divisor there, must (in a corresponding Case) be a Multiplier here; also, instead of annexing 0's (as you did there to your Multiplicand) you must point off a like Number (in your Dividend) for Decimals here, the Product thus found is your Quote sought.

Ex. Divide 263836976853 by $14285\frac{5}{7}$, giving only the Quote.

$$\begin{array}{r} 2638369,76853 \\ \times 7 \\ \hline \end{array}$$

Answer 18468588,37971 the Quote sought.

29.

29.

To divide by a Fraction, without multiplying by its Denominator.

Rule. Divide your given Dividend by the Numerator of the Divisor; this Quote multiply by the Difference of the Numerator and Denominator of your Divisor, and add the Product to your Dividend, if the given Divisor be a proper Fraction, otherwise subtract, the Sum or Remainder is the Quote sought.

Example. Divide 5888472 by $\frac{6722}{6723}$.

```
6722 ) 5888472 (   +876
        51087     -------
         40332    5889348 the Quote sought.
        ------
           0
```

30.

To find the Quote of any Number divided by any Number of 9's, by Addition or Subtraction.

Rule. Add the left-hand Figure of every partial Dividend to the rest of that Dividend; then if this Sum is less than the Divisor, the added Figure is the Quotient-figure, and the Sum is the just Remainder at that Step; and so proceed while the Sum is less than the Divisor. 2d. But if the Sum exceeds the Divisor, at any Step, the Quote-figure (of that Step) is equal to the added Figure plus 1, and the Divisor subtracted from the foresaid Sum leaves the Remainder of that Step.

Note. *If all the Figures in any partial Dividend are 9's, the Quote is* 1, *and the Remainder* 0.—*But if the partial Dividend is less than the Divisor, put* 0 *in*

in the Quote, and bring down your next Figure (as in common.)

Ex. Divide 46789837568 by 999999
+ 4
6789877 (46789 Quote.
+ 6
7898835
7
8988426
+ 8
9884348
+ 9
884357 Remainder.

Example. To the second Part of the Rule divide 49984627 by 999.

49984627 (50034 Quote.
+ 4
Sum 1002
Divisor — 999
3462
+ 3
4657
+ 4
661 Remainder.

31.

To divide by any Number, whose right-hand Figure is any Digit, the rest being 9's, without multiplying the Divisor by the Quotient-figure at any Step.

Rule. Apply the foregoing Rule, except in this Particular, *viz.* instead of adding the left-hand Figure

gure of the partial Dividend at every Step (as before) add the Product of this Figure by the Excess of 10, above the right-hand Figure of the Divisor.

Ex. Divide ~~4~~6789837568 by 999996 | 10
+ 16 = 4×4 (46790 Quote. | —6

~~6~~789997 Excess 4
+ 24 = 4 × 6

~~7~~900215
+ 28 = 4 × 7

~~9~~002436
+ 36 = 4 × 9

..24728 Remainder.

Note, *The left-hand Figure of the Dividend may be added at every Step without putting it down.*

32.

To perform Division of Decimals short, when there are many Decimals in the Dividend, and the Divisor is large.

Rule 1. Whatever Place of the Dividend corresponds with the Unit's Place of the Divisor at the first Step of the Division, the same Place must the first Figure of the Quote have.

2. In the Division, reject the last right-hand Figure of the Divisor at every Step (instead of bringing down a Figure, as in common) and make the last Remainder the Dividend for the new Divisor at every Step; and thus continue the Division till the Divisor is exhausted.

Ex. 99,5678) 4,678983756\overline{8}(,0469931 Quote.
99,567 | 696271
9,956 | 98869
9,95 | 9265
9,9 | 310
9, | 13
4 Remainder.

I have here put down every Divisor to explain the Work. But you need only put a Dash over every Figure rejected as you proceed, to shew it is omitted.

Note, *At the first Step, we seek how oft* 9 *into* 4,6 (*or* 99, *into* 4,67); *therefore the* 9 *in the Unit's Place of the Divisor, corresponds with the* 7 *in the second decimal Place of the Dividend; therefore* (*by the Rule*) *the first Figure* (4) *of the Quote must be put in the second decimal Place.*

33.

To divide by 2, *beginning the Work at the Unit's Place of the Dividend, and proceeding from right to left.*

Rule. Put down the half of the greatest even Number in every Digit, (proceeding from right to left) except when an odd Number precedes (or is to the left of) the Digit you are halving, in which Case add 5 to the half of the greatest even Number in the Digit (or Cypher) and put down the Sum.

Note, *Instead of adding* 5 *to half the Digit, you may* (*if you please*) *add* 10 *to the Digit, and put down half the Sum exclusive of the odd* 1 (*if any*.)

Example. 4674982 (2

2337491 Quote.

Thus

Thus

The $\frac{1}{2}$ of 2 is 1 | the $\frac{1}{2}$ of 18 is 9 | the $\frac{1}{2}$ of 9 is 4 | the $\frac{1}{2}$ of 14 is 7 | the $\frac{1}{2}$ of 7 is 3 | the $\frac{1}{2}$ of 6 is 3 | the $\frac{1}{2}$ of 4 is 2 | .

The Uſe of this is, that we may multiply by any Number, and the Fraction $\frac{1}{2}$, without putting down a Line in the Work for the Fraction.

And this may be done, by adding the half of every Figure (in the Multiplicand) to the Product of that Figure by the multiplying Digit, as you multiply.

Example. 4674982
$\times\ 9\frac{1}{2}$

44412329 Product by $9\frac{1}{2}$.

9 times 2 is 18, and 1 is 19 | 9 times 8 is 72, and 1 is 73, and 9 is 82, &c.

34.

To divide different Denominations, by different Denominations of the ſame kind, without any Reduction; the higheſt Denomination of Diviſor and Dividend being the ſame.

Rule. Seek how oft the whole Diviſor is contain'd in the firſt, or two, or three, *&c.* firſt Figures of the whole Number of the Dividend (rejecting the inferior Denominations of the Dividend till all the whole Numbers thereof are brought down) put the proper Figure in the Quote; then from the partial Dividend (or whole Number uſed) ſubtract the Product of the whole Diviſor and Quote-figure; to the Remainder, multiplied by 10, add the next Figure of the whole

Number of the Dividend, this Sum is the new Dividend for the next Step, to be divided by the given Divisor as before, and thus proceed till you have brought down all the Figures of the whole Number of the given Dividend; then to the last Remainder add the inferior Denominations of the given Dividend; if the Sum is less than the whole (or given) Divisor, it is the complete Remainder; but if not, divide it by the given Divisor, and add (not annex) this Quote-figure to the former Quote, the Remainder at this Step is the complete Remainder of the proposed Division.

Note, *The multiplying of the Remainder at every Step by* 10, *is no other than what is done in all Divisions; since to annex a Figure, is the same thing as to multiply by* 10, *and add the Figure annexed.*

	l.	*s.*	*d.*		*l.*	*s.*	*d.*
Ex. 1. Divide	864	13	9	by	3	9	8.

l.	*s.*	*d.*		*l.*	*s.*	*d.*	
3	9	8	)	864	.	.	(248 Abstract.
			)	16	00	80	Product by 10 + 6 *l.*
				24	40	480	Product by 10 + 4 *l.*
				+ 40			
			)	28	13	9	+ 13 *s.* 9 *d.* brought down.
					16	5	complete Remainder.

Ex.

Ex. 2. Admit the Content of a certain Street in *London* to be 20357 Feet, 6′, 4″, the Length being 649 Feet, 8 In. 6 Parts, I demand the Breadth, without any Reduction of the given Terms.

F. I. P. F. I. P. F. I.
649 8 6) 20357 — 6 — 4 (31 4 Anſwer.
) 857—106—64
208 — 98—58
+8 +4
) 216 — 6—10
0 Remainder.

In the firſt Example we ſave 32 Figures in the Work, in the ſecond 43 Figures are ſaved.

THE RULE OF THREE DIRECT.

35.

A general Rule to work by Multiplication only.

Rule. Turn the firſt Term (or Diviſor) into a reciprocal decimal Fraction, and multiply the Product of your ſecond and third Terms by this Decimal, the laſt Product is the fourth Term ſought.

Ex. If I pay 496 *l.* 15 *s.* 6 *d.* for 625 Yards of Cloth, what will 125 Yards coſt at that Rate?

$$\begin{array}{r} 496{,}775\ l. \\ \times\ 125 \\ \hline 2483875 \\ 5961300 \\ \hline 62096{,}875 \\ \times\ ,..16 \text{ reciprocal Decimal.} \\ \hline \text{Anſwer } l.\ 99{,}355.... \end{array}$$

36.

To work all Caſes by Diviſion only.

Rule. Divide the firſt Term (or Diviſor) by either of the other two Terms, the other of theſe two Terms, divided by this Quotient, quotes the fourth Term.

Yds.

	Yds.		*l.*	*s.*	*d.*		Yds.
Ex. If	625	coſt	496	15	6,	what coſt	125?
	125)—						
	Quote 5		)———				
			Anſ. 99	7	$1\frac{1}{5}$		

The common Rule gives above one hundred Figures in the Work. And here, the firſt Example is wrought by leſs than half that Number; and the ſecond by 4 Figures, beſides Queſtion and Anſwer.

37.

When the middle Term conſiſts of different Denominations, then, inſtead of bringing it to the loweſt, you may (if you pleaſe) bring it to the higheſt, by increaſing the firſt Term, or decreaſing the third in the ſame Proportion as you have increaſed the middle Term.

	Yds.		*l.*	*s.*	*d.*		Yds.
Ex. If	25	coſt	14	12	6,	what coſt	36?
	×8			×8			
	2,00	)	1,17				
			,585 Quote.				
			×6				
			3,510				
			×6				

Anſwer 21,06 = 21 *l.* 1 *s.* $2\frac{2}{5}$ *d.*

Or

Or thus,

```
25——14  12  6——36
 2          ×8   4)—
 —      ————      9
       117
       ×9
       ————
5,0) 105,3
     ————
```

Anſwer 21,06 as above.

40 Figures ſaved in the Work by either Method.

38.

When the middle Term contains ſeveral Denominations, you need not reduce it as the common Rule directs.

Rule. Multiply the middle Term in the given Form by the component Parts of the third Term (if 'tis a compoſite) and divide the Product by the firſt Term; reducing the laſt Remainder of every Denomination to the next lower Denomination, and adding thereto the reſt of the ſame Denomination, which Sum divide by the given Diviſor, and ſo proceed.

But obſerve, if the third Term is a prime Number, then after having multiplied by the component Parts of the neareſt Compoſite; to or from this Product add or ſubtract the Product of the middle Term by the Difference of the compoſite and third Number, according as the Compoſite exceeds, or is leſs than the third Term; *viz.* ſubtract if the Compoſite exceeds, otherwiſe add, the Sum or Remainder is the Anſwer.

Yds.

	Yds.		*l.*	*s.*	*d.*		Yds.
Ex. If	625	cost	496	15	6,	what cost	128 ?
					×5		
			2483	17	6		
					×5		
			12419	7	6		
					×5		
			62096	17	6	=125 times the m. T.	
			+ 1490	6	6	=3 times the mid. T.	

625) 63587 4 (101 14 $9\frac{303}{625}$ Ansſw.
1087
462
×20

) 9244 (14 *s.*
2994
494
×12

) 5928 (9 *d.*
$\frac{303}{625}$.

Or

Or thus,

Rule. For the Product of the second and third Terms, apply the Rule given in Multiplication (p. 18.) and for the Division proceed as above.

```
            l.          s.        d.
           496———————15————————6
           992         30       12
           3968        120       48
          ———————     ——————   ———   l.   s.   d.
625 ) 63488       1920     768( 101  14  9 303/625 Anf.
           988
           363
           ×20
          ———————
         ) 9180 s.
           2930
            430
            × 12
          ———————
          ) 5928 d.
             303
```

Or thus,

Rule. Apply the Rule given (p. 23. Art. 24.) for the Product.

```
                          496  15  6
            00 d.         ————————————
By 120      6|0 s.        3974   4  by 8
            —             59613
            3 l.          ————— ————    l.   s.   d.
                 625)63587   4( 101  14  9 303/625 Anfwer.
                     1087
                      462
                     ——————
                   ) 9244 (
                     2994
                      494
                     ——————
                   ) 5928 (
                      303
```

I

I have not wrote down the Multipliers 20 and 12 here, nor is it ever neceſſary, they being always known; for which reaſon I ſhall generally omit writing them (and all ſuch common Multipliers) down for the future; which the Reader is deſir'd to remember.

Note, *Theſe Rules are applicable to all Caſes, for if there are given odd Weights or Meaſures in the third Term, you may multiply by the whole Number as above, and find the Value of the odd Weight,* &c. *by the Rule of Practice, which add to the former Product.*

39.

When the firſt Term is neither an aliquot Part nor Multiple of the third, and is leſs than the third Term,

Rule. Divide the third by the firſt, and multiply the middle Term by the integral Quote, to the Product add the Price of the Remainder.

	Yds.		*l.*	*s.*	*d.*		Yds.
Ex. If	35	coſt	42	16	$11\frac{1}{2}$,	what coſt	322?
					$\times 9$	35)	(9 Quote.
							7 Remaind.
			385	12	$7\frac{1}{2}$		
$7 = \frac{1}{5} =$			$+8$	11	$4\frac{7}{10}$		
	Anſwer		394	4	$0\frac{1}{5}$		

70 Figures ſaved in the Work.

Caſe 2. *When the firſt exceeds the third, and is neither an aliquot Part nor Multiple thereof,*

Rule. Divide the firſt by the third, and from the middle Term ſubtract the Price of the Remainder;

I this

this laſt Remainder divided by the integral Quotient quotes the fourth Term.

	Yds.		*l.*	*s.*	*d.*		Yds.
Ex.	35	———	42	16	$11\frac{1}{2}$	———	6.
	6) (5 Quote.						
Rem.	$5 = \frac{1}{7} =$	—	6	2	$5\frac{1}{14}$		= Price of 5 Y.
		Quote 5)	36	14	$6\frac{3}{7}$		= Pr. of 30 Y.
		Anſwer	7	6	$10\frac{31}{35}$		= Price of 6 Y.

70 Figures ſaved in the Work.

40.

When the Difference of the firſt and third Numbers, is an aliquot Part or Multiple of the firſt,

Rule. Take a like Part or Multiple of the middle Term, as the Difference of the firſt and third is of the firſt, and add it to the middle Term if the third exceeds the firſt, (2d) otherwiſe ſubtract; the Sum or Remainder is the fourth Term.

	Y.		*l.*	*s.*	*d.*		Y.
Caſe 1.	30	—	36	14	6	———	35
Diff.	5)	—(6) +	6	2	5	—	30
							5 Diff.
		Anſwer	42	16	11 Sum		= Price of 35 Y.

	Y.		*l.*	*s.*	*d.*		Y.
Caſe 2.	35	—	42	16	11	———	30.
	5)	—(7) —	6	2	5		
		Anſwer	36	14	6 Diff.		= Price of 30 Y.

The

The common Rule gives 45 Figures in the Work, but by this Rule, the first Example is wrought by 9 Figures, and the second by 5.

41.

To work all Cases of the Rule of the Three Direct, without finding the Product of the second and third Terms.

General Rule.

Multiply the middle Term by the Difference of the first and third Terms, and divide this Product by the first Term.

Then

If the third Term exceeds the first, add the Quote to the middle Term, otherwise subtract; the Sum or Remainder is the fourth Term.

Example 1.

Yards.		*l.*	*s.*	*d.*		Yards.
If 14284224	cost	946798	19	$9\frac{3}{4}$,	what cost	14284188
396784		) 153230		(2 *l.*		396783

Divis. reduc'd

) 3064619 (7 *s.*
287131

) 344558 1 (8 *d.*
271309

) 1085239 (2 *f.*
291671

	l.	*s.*	*d.*	*f.*
	946798	19	9	3
	— 2	7	8	$2\frac{291671}{396784}$
Answer	946796	12	1	$0\frac{105113}{396784}$

Here are above 300 Figures saved by the Contraction.

Y.

	Y.	l.	s.	d.		Y.	
Ex. 2.	35 —	26	19	7	——	37	
				× 2		−35	
						2	Difference.

35) 53 19 2 (+1 10 10 Price of 2 Y.
18   26 19 7 Pr. of 35 Y.

) 379   Anf. 28 10 5 Pr. of 37 Y.
29

) 350

0

42.

It is common in the Rule of Three, to divide the firft Term, and one of the other two Terms, by fome common Meafure (when they have any fuch) and then to ufe the Quotients inftead of the Terms divided (which fhortens the Work). But this Reduction is not limited to a common Meafure (as is generally underftood) for it holds alfo when the common Divifor is not a common Meafure to the Terms divided; and therefore may be applied more generally.

	Yds.		l.	s.	d.		Yds.
Ex. 1.	144	——	496	15	6	——	126
		12)				12)	
			41	7	$11\frac{1}{2}$		$10\frac{1}{2}$
				×	$10\frac{1}{2}$		
			413	19	7		
			+20	13	$11\frac{3}{4}$		
		Anfwer	434	13	$6\frac{3}{4}$		

Or

Or thus.

12) 496 15 6

Sub. the Sum of these $\begin{cases} 41 & 7 & 11\frac{1}{2} \\ 20 & 13 & 11\frac{3}{4} \end{cases}$

Answer 434 13 $6\frac{3}{4}$

In either of these we save above 60 Figures in the Work.

	Y.	£.	Y.
Ex. 2.	126 ——	434,678125 ——	144
	12)	× 12	

10,5) 5216,1375.. (496,775
1016
711
813
787
525
...

50 Figures saved in the Work of this Example.

43.

To prove all Sums of the Rule of Three by the Rule of Practice.

Rule. Find the Product of the first and fourth Terms, and the Product of the second and third Terms, by the Rule of Practice (as *per* Example) if these two Products are equal, the fourth Term (or Answer) is right, otherwise not.

Ex. Suppose these four Terms were given to prove the fourth Term.

Ct.	q.	lb.		Ct.	q.	lb.		l.	s.	d.		l.	s.	d.
563	3	14	—	140	3	24½	—	46	11	4	—	11	12	10

	l.	s.	d.
	563	17	6
×	11	12	10
	6202	12	6
10s = ½ =	281	18	9
2s. 6d. = ¼ =	70	9	8¼
4d. = 1/30 =	9	7	11½
Pr. Ex. =	6564	8	10¾

Proof.

	l.	s.	d.
	46	11	4
	184	44	16
	6440	1540	560
	+79	+46	8d
	6519	6	8
2q. = ½ =	23	5	8
1q. = ½ =	11	12	10
16lb. = 1/7 =	6	13	0 4/7
8lb. = ½ =	3	6	6 2/7
½lb. = 1/16 =	0	4	1 25/28
Product means =	6564	8	10¾

Or thus, by Art. 24.

	l.	s.	d.	
by Art. 46, 47.	=56	7	9	l. d. 11 12 .116 = ½s
30d.	338	6	6	
5 | 2s.	6202	12	6	
6d. = ¼ =	14	1	11¼	
4d. = 1/6 =	9	7	11½	
Pr. =	6564	8	10¾	Ext.

	l.	s.	d.	
	14	1	11¼	by Art. 46, 47.
				465 s.
	70	9	8¼	
	845	16	3	20 f.
	5638	15	0	75 d.
				11 | 6 s.
1s. = ½ =	7	0	11⅝	900 d.
4d. = ⅓ =	2	6	11⅞	77 | 5
Pr. =	6564	8	10¾	mean

44.

PRACTICE.

The Application of this Rule in Business is generally understood (and taught) as limited to those particular Kinds of Questions in the Rule of Three Direct, whose first Term (in the Stating) is an Unit. But when the first Term is a large whole Number, or consists of several Denominations; the Rule of Practice has not (to my Knowledge) been applied in these Cases; but they are always referr'd to the Rule of Three.

Therefore, as the Rule of Practice is a short and easy Method of solving all Questions to which it is applicable, I shall give a general Rule how to apply it to all mercantile Questions of the Rule of Three Direct (whatever the first Term is) and independent on this Rule.

General Rule.

When the Price of several things is given, and 'tis requir'd to find the Price of several Denominations of that Kind, at the same Rate;

Suppose the given Price to be the Price of one of the given Things, and find the Price of the other given Quantity at that (supposed) Rate, by the Rule of Practice; then divide this false Value by the Number whose Price was given, the Quotient is the Price sought.

But, obſerve, that if that Quantity whoſe Price is given (in the Queſtion) conſiſts of ſeveral Denominations, then you muſt (before you divide by it) reduce it to one Denomination, and then multiply the falſe Value (found by Practice) by that Number which you have uſed as Multiplier in the Reduction of the firſt Quantity, and then proceed to the Diviſion.

Ex. If I pay 46 *l.* 10 *s.* 4 *d.* for 100 Ct. what will 500 Ct. 3 q. 14 ℔. coſt, at the ſame Rate?

	l.	*s.*	*d.*
	46	10	4
	× 500		
	23000		
10 *s.* = $\frac{1}{2}$ =	250		
4 *d.* = $\frac{1}{30}$ =	.8	6	8
2 q. = $\frac{1}{2}$ =	23	5	2
1 q. = $\frac{1}{2}$ =	11	12	7
14 ℔. = $\frac{1}{2}$ =	5	16	$3\frac{1}{2}$
	232 | 99	..	$8\frac{1}{2}$
	19 | 80		
	9 | 68		
	137		

Or thus.

	l.	*s.*	*d.*
	46	10	4
	23258	6	8
	23	5	2
	11	12	7
	5	16	$3\frac{1}{2}$
l.	232|99	..	$8\frac{1}{2}$
s.	19|80		
d.	9|68		
	137		

800
116|6

Anſw. 232 *l.* 19 *s.* $9\frac{137}{200}$ *d.*

Here we ſave above 100 Figures in the Work.

	Ct.	q.		*l.*	*s.*		Ct.	q.	lb.
Ex. 2. If	4	3	cost	6	10,	what cost	6	2	14?
	×4			×6					
	19			39	·				
				3	5				
				0	16	3			
				43	1	3			
					×4				

			l.	*s.*	*d.*	
19)	172	5	(9	1	$3\frac{15}{19}$	Answer.
	1					
	) 25 *s.*					
	6					
	) 72 *d.*					
	15					

Here we have the Work in less than half the Number of Figures requisite by the common Rule of Three.

	Ct. q.		l. s. d.		Ct. q. ℔.
Ex. 3. If	8 3	coſt	54 10 8,	what coſt	45 2 16?

		l.	s.	d.
×4			×9	
35		490	16	
			×5	
		2454		
		27	5	4
		7	15	$9\frac{5}{7}$
		2489	1	$1\frac{5}{7}$
				×4
	7)	9956	4	$6\frac{6}{7}$
	5)	1422	6	$4\frac{20}{49}$
	Anſwer	284	9	$3\frac{69}{343}$.

Ex. 4. What coſt 470 T. 17 Ct. 2 q. if for 24 Ton I pay 396 *l.* 14 *s.* $7\frac{1}{4}$ *d?*

	l.	*s.*	*d.*	*q.*	
8)	396	14	7	1	30
					27
	27771	2	3	2	2|2
	158692	1	8	0	
	~~49~~	~~11~~	~~9~~	~~3~~$\frac{5}{8}$	
	347	2	9	$1\frac{7}{8}$	500
					184|1
4)	186810	6	8	$3\frac{3}{8}$	
6)	46702	11	8	$0\frac{27}{32}$	
Anſwer	7783	15	3	$1\frac{91}{192}$.	

Ex,

Ex. 5. If I pay 54*l.* 10*s.* 8*d.* for 36 Ct. 3q. 20 ℔. what will 470 Ct. 2q. 24 ℔. coſt?

		l.	*s.*	*d.*				
		54	10	8				
		3817	6	8			80	800
		21813	6	8			14|6	26|6
		27	5	4			—	—
		7	15	$9\frac{5}{7}$				
		3	17	$10\frac{6}{7}$				
36 3 20		25669	12	$4\frac{4}{7}$				
×4 +5				×7				
147		179687	6	8				
×7				×2				
					l.	*s.*	*d.*	
2) 1034	(517)	359374	13	4	(695	2	$3\frac{361}{517}$	Anſw.
		4917						
		2644						
		59						
		) 1193*s.*						
		159						
		) 1912*d.*						
		361						

The 3d and 4th Examples are wrought in half the Number of Figures requiſite by the common Rules; and in the 5th Example, we ſave 50 Figures in the Work.

45.

But as this Method of multiplying (by Art. 24.) is very expeditious and eaſy, I ſhall give ſome more Examples in the common Caſes of Practice.

	l.	s.	d.	
Ex. 6. Requir'd the Am^t. of 10 at	27	17	$8\frac{3}{4}$	for 1.
Anſwer	278	17	$3\frac{1}{2}$	

4) 30 | 2 *f.*

12) 87 | 3 *d.*

17 *s.*

	l.	s.	d.
Ex. 7. Requir'd the Amount of 100 at	27	17	$8\frac{3}{4}$.
	2788	12	11

4) 300 | 0 *f.*

12) 875 | 11 *d.*

2'0) 17|2 | 12 *s.*

8 *l.*

	l.	s.	d.		
Ex. 8. 1000 at	27	17	$8\frac{3}{4}$	for 1.	3000 *f.*
					8750 *d.*
Anſwer	27886	9	2		1729 *s.*

In this Example I have not wrote down the Remainders and Diviſors in the Margin; nor is it neceſſary in any Caſe, ſince the Remainders may as

eaſily be transferr'd to their proper Places in the Product as they are found, and the Diviſors are always known; therefore I ſhall omit that unneceſſary Work in the following Examples.

		l.	*s.*	*d.*	
Ex. 9.	40 at	27	17	$8\frac{3}{4}$	
		1115	9	2	{110 *d.* / 109 *s.*

		l.	*s.*	*d.*	
Ex. 10.	110 at	15	13	$7\frac{1}{2}$	$\frac{1}{2}$ Pence 10
					d. 105
	Anſwer	1724	18	9	*s.* 98

		l.	*s.*	*d.*	
Ex. 11.	1200 at	15	13	$7\frac{1}{2}$	
	Anſwer	18817	10	0	{600 *d.* / 350 *s.*

Ex. 12.

	l.	*s.*	*d.*		
330088 at	476	16	$9\frac{1}{4}$	$=a$	
	3814	14	2	$=b=8a$	30000 *f.*
	38147	1	8	$=c=10b$	
	14305156	5	0	$=d=30000a$	37500 *d.*
	143051562	10	0	$=10d$	103125 *s.*
Anſ.	157398680	10	10		

Ex. 13. Requir'd the Amount of 384 Ct. 2 q. 10 ℔. at 42 *l.* 19 *s.* $2\frac{3}{4}$ *d.* *per* Ct.

			l.	*s.*	*d.*
by 80 { 100 *d.* / 138 *s.*			42	19	$2\frac{3}{4}$
		by 4 =	171	16	11
by 300 { 100 *f.* / 825 *d.* / 1768 *s.*		by 80 =	3436	18	4
		by 300 =	12888	8	9
		by 384 =	16497	4	0
		for the odd Wt. add	25	6	4
		Anſwer	16522	10	4

		l.	*s.*	*d.*	
		42	19	$2\frac{3}{4}$	
2 q.	$= \frac{1}{2} =$	21	9	7	$1\frac{1}{2}$
8 ℔.	$= \frac{1}{7} =$	3	1	4	2
2 ℔.	$= \frac{1}{4} =$	0	15	4	$0\frac{1}{2}$
		25	6	4	

From all which it is evident, that however large or complex the third Term in the (Stating of the) Rule of Three is, yet there is no need to reduce the middle Term to one Denomination; ſince the Product of the ſecond and third Terms can always be found by the Rule of Practice, and conſequently the firſt and third Terms need not be reduc'd to one Denomination.

46.

46.

To solve all Cases of Practice by the aliquot Parts and Multiples of 2 s. viz. *by first finding the Price at 2 Shillings, whatever the given Price is.*

Rule. First find the Price of the given Quantity at 2 *s.* and then take such Parts or Multiples of the Price at 2 *s.* as the given Price is of 2 *s.* for the Price sought.

But as the Advantage of this Method depends upon the ready Methods of finding the Amount at 2 *s.* I shall shew the best Methods of doing this. Thus,

To find the Amount of any whole Number, at the Rate of 2 s. *for* 1.

Rule. Double the right-hand Figure of the given Number (whose Price is sought) for Shillings, the rest are Pounds.

Ex. 1. What cost 156 Yards of Cloth at 2 *s. per* Yard?

Here the right-hand Figure 6, being doubled, is 12 *s.* and the Remainder 15, I account 15 *l.* therefore the Amount of 156 Yards at 2 *s.* is 15 *l.* 12 *s.*

Now if 1 costs 2 *s.* 1 Quarter will cost 6 Pence, therefore $156\frac{3}{4}$ Yards at 2 *s. per* Yard will cost 15 *l.* 13 *s.* 6 *d.* and if 1 Quarter costs 6 Pence, than $\frac{1}{2}$ a Quarter will cost 3 *d.* &c. Hence 156 Ct. 3 q. 14 ℔. at 2 *s. per* Ct. will cost 15 *l.* 13 *s.* 9 *d.* and in like Manner in any other Case.

Hence the Price of any given whole Number, with Quarters and Half-quarters, *&c.* may be easily calculated in mind.

47.

47.

To find the Price of any Number of ℔*'s at* 2 s. *per Ct.*

Rule. Esteem the given ℔'s as so many Farthings, and from these Farthings subtract the 7th Part thereof, the Remainder is the Price sought, in Farthings.

Ex. 2. What cost 27 ℔. at 2 *s. per* Ct?

$$7)\ 27 \text{ Farthings.}$$
$$-\ 3\tfrac{6}{7}$$

Answer $23\frac{1}{7}$ Farthings.

Hence, the Amount of any Number of Hundreds, Quarters, and Pounds, at 2 *s. per* Ct. may be easily calculated in mind.

Ex. 3. What cost 364 Ct. 3 q. 27 ℔. at 2 *s. per* Ct?

364 Ct. at 2 *s. per* Ct. comes to 36 *l.* 8 *s.* and 3 Quarters comes to 1 *s.* 6 *d.* which added to 36 *l.* 8 *s.* makes 36 *l.* 9 *s.* 6 *d.* and 27 ℔. comes to 5 *d.* $3\frac{1}{7}$ *q.* therefore the whole Amount is 36 *l.* 9 *s.* 11 *d.* $3\frac{1}{7}$ *q.*

And he must be a dull Accomptant indeed, who cannot perform this, and all such Operations in mind. For which reason I shall, in the following Examples, suppose these kind of Operations so perform'd, and therefore shall put down only the Result.

48.

Or thus.

Rule. Esteem the right-hand Figure of the given whole Number as so many Shillings, and account the

the reſt as Pounds; alſo ſuppoſe the Fraction (if any) a Fraction of a Shilling, writing down the Value in Pence. Then take ſuch Parts of the Pounds as the given Price is of 2*s.* and to this Reſult add the Quote of the odd Money, divided by half the Diviſor to the Pounds.

Ex. 4. What coſt 1568 Yards at 6 *d.* each?

	l.		*s.*
4)	156	2)	8
Anſwer	39		4 *s.*

Ex. 5. 1568$\frac{3}{4}$ Yards at 6 *d.*

	l.		*s.*	*d.*
4)	156	2)	8	9
Anſwer	39 *l.*		4 *s.*	4$\frac{1}{2}$ *d.*

49.

Or thus, for whole Numbers.

Rule. Account the given Number ſo many 2 *s.* Pieces; then (this being the Price at 2 *s.* each) take ſuch Parts (or Multiple) of theſe 2 *s.* Pieces, as the given Price is of 2 *s.* and to bring theſe to Pounds, double the right-hand Figure for Shillings, the reſt are Pounds.

Ex.

Ex. 6. What coſt 4879 Yards at 3 *d.* *per* Yard?

2 *s.* Pˢ.
4879 at 2 *s.* each.

3 *d.* = $\frac{1}{8}$ of 2 *s.* = 60 | 9 1 *s.* 9 *d.*
| ×2

Anſwer 60 *l.* 19 *s.* 9 *d.*

Ex. 7. 4879 at 9 *d.*

2 *s.* Pˢ.
4879

		s.	*d.*
6 *d.* = $\frac{1}{4}$ of 2 *s.* =	1219	1	6
3 *d.* = $\frac{1}{2}$ =	609	1	9
l.	182 | 9	1	3
	| 2		

19 *s.* 3 *d.*

Or thus.
4879

		s.	*d.*
3 *d.* = $\frac{1}{8}$ =	609	1	9
			×3
l.	182 | 9	1	3
	| 2		

19 *s.* 3 *d.*

Anſwer 182 *l.* 19 *s.* 3 *d.*

Ex. 8. 9747 at 21 Pence.

3 *d.* = $\frac{1}{8}$ = 1218 0 *s.* 9 *d.* at 3 *d.*
×7

Anſwer *l.* 852 | 8 1 3
| 2

and 17 *s.* 3 *d.*

Ex.

Ex. 9. 8375 at 19 $d.$

		$s.$	$d.$
$6d. = \frac{1}{4} =$	2093	1	6
			$\times 3$
	6281	0	6
$1d. = \frac{1}{6} =$	348	1	11
Answer $l.$	663|0|	0	5

Or thus.

8375

		$s.$	$d.$
$1s. = \frac{1}{2} =$	4187	1	0
$6d. = \frac{1}{2} =$	2093	1	6
$1d. = \frac{1}{6} =$	348	1	11
	663|0|	0	5

Answer 663 $l.$ 0 $s.$ 5 $d.$

Ex. 10. 3649 at $22\frac{1}{2}$

$2d. = \frac{1}{12} =$	304	0 $s.$	2 $d.$
			$\times 11$
at 22 $d.$	3344	1	10
$\frac{1}{2} d. = \frac{1}{4} =$	76	0	$0\frac{1}{2}$
Answer	342|0|	1	$10\frac{1}{2}$

Or thus.

3649

$3d. = \frac{1}{8} =$	~~456~~	~~0~~	~~3~~
$1\frac{1}{2} d. = \frac{1}{2} =$	$-$ 228	0	$1\frac{1}{2}$
Answer	342|0|	1	$10\frac{1}{2}$

50.

To find the Price at any Number of Shillings each.

Rule. Multiply the given Number (whoſe Price is ſought) by $\frac{1}{2}$ the given Number of Shillings; and double the right-hand Figure of the Product for Shillings, the reſt are Pounds.

Ex. 11. 7328 at 16 $s.$

$\times 8 = \frac{1}{2}$ of 16

Answer $l.$ 5862\| 4

$\times 2$

and 8 $s.$

Ex.

2

Ex. 12. 79623 at 24 *s.*
$\times$ 12 = $\frac{1}{2}$ of 24

Anſwer *l.* 95547 | 6
$\times$ 2

12 *s.*

Ex. 13. 8624 at 19 *s.*
$\times$ $9\frac{1}{2}$ = $\frac{1}{2}$ of 119

77616
4312

Anſwer *l.* 8192 | 8
$\times$ 2

16 *s.*

Or thus, by Art. 33.

8624
$\times 9\frac{1}{2}$

l. 8192 | 8
2

16 *s.*

Ex. 14. 94073 at 13 *s.*
$\times 6\frac{1}{2}$

Anſwer *l.* 61147 | $4\frac{1}{2}$
2

9 *s.*

Ex.

	Ct.	q.	lb.		l.	s.	d.
Ex. 15.	567	1	7	at	3	18	8.
	× 39						

	510	6 s.	
	1701	0	
8 d. = $\frac{1}{3}$ =	18	18	
1 q. = $\frac{1}{4}$ =	0	19	8 d.
7 lb. = $\frac{1}{4}$ =	0	4	11
Answer	2231	8	7

Or thus, by Art. 46 and 47.

	l.	s.	d.	
	56	14	$7\frac{1}{2}$ at 2 s.	
			× 9 = $\frac{1}{2}$ of 18 s.	
	510	11	$7\frac{1}{2}$	2) 10
Product by 30 =	1701	18	9	105
8 d. = $\frac{1}{3}$ =	18	18	$2\frac{1}{2}$	3|8
Answer	2231	8	7	

But as Rules 46, 47. may be applied with the ſame Expedition and Eaſe when the given Number is mixt as when 'tis whole (theſe Rules requiring no more Lines in the Work on account of the given odd Weight) I ſhall give ſome more Examples therein.

	Gal.	q.		s.	d.	
Ex. 16. What coſt	367	2	at	14	9	*per* Gallon?

	l.	s.	d.	
	36	15		
		× 7		= $\frac{1}{2}$ of 14*s.*
	257	5		
6*d.* = $\frac{1}{4}$ =	9	3	9	
3*d.* = $\frac{1}{2}$ =	4	11	10$\frac{1}{2}$	
Anſwer	271	0	7$\frac{1}{2}$	

	G.	q.	p.		s.	d.
Ex. 17.	89	3	2	at	9	4.

	l.	s.	d.	
2)	8	19	9	Price at 2*s.*
3)	4	9	10$\frac{1}{2}$	at 1*s.*
			× 9	
	40	8	10$\frac{1}{2}$	
4*d.* = $\frac{1}{3}$ =	1	9	11$\frac{1}{2}$	
Anſwer	41	18	10	

Or thus.

	l.	s.	d.	
	8	19	9	
			4$\frac{1}{2}$	= $\frac{1}{2}$ of 9*s.*
	35	19	0	
	4	9	10$\frac{1}{2}$	
4*d.* = $\frac{1}{6}$ =	1	9	11$\frac{1}{2}$	
Anſwer	41	18	10	

Ex.

Ex. 18. If 1 Ct. costs 11 *l.* 12*s.* 10 *d.* what cost 563 Ct. 3 q. 14 lb?

	l.	*s.*	*d.*	
By Art. 46, 47.	56	7	9	= the Price at 2 *s. per* Ct.
		$\times$ 6		
By Art. 24. { 30 *d.* / 5|2 *s.*	338	6	6	
	6202	12	6	
6*d.* = $\frac{1}{4}$ =	14	1	$11\frac{1}{4}$	
4*d.* = $\frac{1}{6}$ =	9	7	$11\frac{1}{2}$	
Answer	6564	8	$10\frac{3}{4}$	

11 12*s.*
20

2) 232 *s.*
116 = $\frac{1}{2}$ the *s.*

If this Example be wrought by the common Rule of Three Direct, 'twill require about four times the Number of Figures here made use of.

Ex. 19. What cost 470 Ct. 2q. 16 lb. at 54 *l.* 10 *s.* 8 *d. per* Ct?

	l.	*s.*	*d.*	*q.*	
	47	1	3	$1\frac{5}{7}$	at 2 *s.*
			$\times$ 5		
	235	6	5	$0\frac{4}{7}$	
	1882	11	5	$0\frac{4}{7}$	
	23532	2	10	$1\frac{1}{7}$	
8*d.* = $\frac{1}{3}$ =	15	13	9	$0\frac{4}{7}$	
Ans.	25665	14	5	$2\frac{6}{7}$	

7) 16
− $2\frac{2}{7}$
$13\frac{5}{7}$ Far.

l.	*s.*
54	10
10	
545 = $\frac{1}{2}$ *s.*	

By 500	By 40
400	60
057	28
514	17
64|2	51

I have here put down every Figure of the Work, (except the marginal Divisors and Remainders, which

 are

are not neceſſary) that the whole may be clear to the Learner; and to ſhew him that the Rule is conciſe, eaſy, and general; and is equally applicable to the Rule of Three.

Note, *The Multiplications in the Margin (by 500, and by 40,) are perform'd by Art.* 24. *which may be always known by the Form of the Work.*

51.

The Price of any Number of Cts. at 1 l. per *Ct. will be as many Pounds as there are Cts. The Price of any Number of Quarters, will be as many Crowns as there are Quarters; the Price of any Number of* ℔s *will be as many times* $2\frac{1}{7}$ *Pence as there are* ℔s.

Hence, to find the Price of any Number of ℔s *at* 1 l. per *Ct. we have this ſhort*

Rule. Divide the given Number of ℔s by 6 and by 7 ſeverally, the former Quote is Shillings, and the Remainder 2 Pences; and the latter Quote is Pence, and the Remainder 7th Parts of a Penny; and the Sum of theſe is the Price ſought.

Ex. 1. What coſt 26 ℔. at 1 *l. per* Ct?

$$
\begin{array}{rll}
7\,.\,6\,)\,26 & & \\
\hline
4\,s.\ 4\,d. & & \text{Quote by 6.} \\
+\ \ 3\frac{5}{7} & & \text{Quote by 7.} \\
\hline
\text{Anſwer } 4\ \ \ 7\frac{5}{7} & &
\end{array}
$$

Ex.

Ex. 2. What cost 23 Ct. 1 q. 25½ ℔. at 1 *l.* *per* Ct?

7 . 6) 25½				
	4 *s.*	3 *d.*	Quote by 6	
	0	3	$2\frac{4}{7}$ q.	Quote by 7
	5	0	Price of 1 Quarter.	
l. 23	0	0	Price of 23 Ct.	

Answer 23 *l.* 9 *s.* 6 *d.* $2\frac{4}{7}$ *q.*

Hence the Price of any Number of Hundreds, Quarters, and Pounds, are easily calculated in mind, and therefore only the Result need be wrote down; and the Price at any other Rate will be such Parts (or Multiple) of this Price, as the given Rate *per* Ct. is of 1 *l.*

Ex. 3. What cost 29 Ct. 2 q. 25½ ℔. at 17 *s.* 6 *d.* *per* Ct?

	l.	*s.*	*d.*	*q.*	
	29	14	6	$2\frac{4}{7}$	at 1 *l.* *per* Ct.
10 *s.* = ½ =	14	17	3	$1\frac{2}{7}$	
5 *s.* = ½ =	7	8	7	$2\frac{9}{14}$	
2 *s.* 6 *d.* = ½ =	3	14	3	$3\frac{9}{28}$	
Answer	26	0	2	$3\frac{1}{4}$	

Or thus.

	l.	*s.*	*d.*	*q.*
8)	29	14	6	$2\frac{4}{7}$
	—3	14	3	$3\frac{9}{28}$
Answer	26	0	2	$3\frac{1}{4}$

If this Example be solved by the Rule of Three, 'twill give 100 Figures in the Work.

Ex. 4. Requir'd the Amount of 364 Ct. 3 q. 27 ℔. at 7 *l.* 10 *s.* 6 *d.* *per* Ct.

7 . 6) 27			
		4*s.*	6*d.*
			$3\frac{6}{7}$
Price of 3 q =		15	
	364	19	$9\frac{6}{7}$ at 1 *l.*
			× 7
	2554	18	9
10 *s.* = $\frac{1}{2}$ =	182	9	$10\frac{13}{14}$
6 *d.* = $\frac{1}{20}$ =	9	2	$5\frac{53}{56}$
Anſwer	2746	11	$1\frac{7}{8}$

Ex.

Ex. 5. What coſt 364 Ct. 3 q. 21 ℔. if I pay 57 *l.* 15 *s.* 6 *d.* for 19 Ct. 3 q. 14 ℔?

	l.	*s.*	*d.*	
	364	18	9	at 1 *l.* *per* Ct.
	~~7919~~	~~10~~		See Art. 44.
	20436	10		
Ct. q.	182	9	$4\frac{1}{2}$	
19 $3\frac{1}{2}$	91	4	$8\frac{1}{4}$	
×4	9	2	$5\frac{5}{8}$	
79	21084	5	$3\frac{3}{8}$	
×2			×8	*l.* *s.* *d.*
159)	168674	2	3	(1060 16 $10\frac{23}{53}$ Anſwer.
	967			
	134			
	) 2682 *s.*			
	1092			
	138			
	) 1659 *d.*			
	69			
	$\frac{23}{53}$ *d.*			

The common Rule of Three gives 100 Figures more in the Work.

52.

Caſe 2. *Any Quantity of Liquor,* &c. *at* 1 l. per *Ton, will coſt as many Pounds as there are Tons, or as many Crowns as there are Hhds; and for the Gallons apply this*

Rule. Divide the given Number of Gallons by 21, and ſubtract the complete Quote from the Number of Gallons, the Remainder is the Value in Pence.

Ex. 1. What coſt 61 Gallons at 20 *s.* *per* Ton?

	Or thus.
21) 61	21) 61
— $2\frac{19}{21}$	— 2^{19}
Anſwer $58\frac{2}{21}$ Pence.	Anſ. $58\frac{2}{21}$ Pence.

You need put down the Denominator of the Fraction in the Anſwer only, as in the ſecond Operation; nor is there any Difficulty in performing the whole Operation in mind. Alſo, if the given Rate is any Parts (or Multiple) of 1 *l.* then the Price ſought will be a like Fraction (or Multiple) of the Price thus found, as the given Rate *per* Ton is of 1 *l.*

So if the Rate was 10 *l.* *per* Ton, then the Price of 61 Gallons would be $580\frac{20}{21}$ Pence.

If the given Rate was 10 *s.* the Price of 61 Gallons would be $29\frac{1}{21}$ Pence, &c.

Ex. 2. Requir'd the Value of 14 Gallons at 20 *s.* *per* Ton.

	Or thus.
21) 14	21) 14
— $0\frac{14}{21}$	— $\frac{2}{3}$
Anſwer $13\frac{7}{21}$ Pence.	Anſwer $13\frac{1}{3}$ Pence.

Ex. 3. What coſt 49 T. 2 Hhd. 60 Gal. at 20 *s.* *per* Ton?

21) 60
— 2^{18}

		s.	*d.*	
$57\frac{1}{7}$ *d.*	or	4	$9\frac{1}{7}$	the Price of 60 Gallons.
		10	.	the Price of 2 Hhd.
	l. 49	.	.	the Price of 49 Ton.
Anſwer	49	14	$9\frac{1}{7}$	

I

I have here put down the Price of each Denomination severally; but this may be done as easily at once, for the Price of the odd Gallons being calculated, the Price of the Tons and Hhds is known by Inspection, and being added thereto in mind, write down the Total at once.

Ex. 4. What cost 56 T. 3 Hhd. 60 G. at 16 *l.* 10 *s.* 10 *d.* *per* Ton?

	l.	*s.*	*d.*		
2)	56	19	$9\frac{1}{7}$	at 1 *l.*	1
2)	560	190	$90\frac{10}{7}$	at 10 *l.*	10
	280	95	$45\frac{5}{7}$	at 5 *l.*	5
12)	28	9	$10\frac{4}{7}$	at 10 *s.*	4
	2	7	$5\frac{37}{42}$	at 10 *d.*	20
Answer	942	13	$6\frac{31}{42}$		

$$\begin{array}{r} 20 \\ \times 6 \\ \hline 120 \\ +37 \\ \hline 42)\,157\,(3d. \\ \frac{31}{42} \end{array}$$

Or thus, by Art. 24.

	l.	*s.*	*d.*
	56	19	$9\frac{1}{7}$
	341	18	$6\frac{6}{7}$
	569	17	$7\frac{3}{7}$
	28	9	$10\frac{4}{7}$
	2	7	$5\frac{37}{42}$
Answer	942	13	$6\frac{31}{42}$

$$\begin{array}{r} 7)\,10 \\ 91 \\ 19|7 \end{array}$$

And thus may the Value of any Number of Tons, Hogsheads, and Gallons be found, at any given Rate *per* Ton, or *per* Hogshead.

53.

Case 3. In Troy Weight.

The Price of any Number of Ounces at 1 l. per *Ounce, will be as many Pounds Sterling as there are Ounces given. The Price of any Number of Pennyweights at* 1 l. per *Ounce, will be as many Shillings as there are Pennyweights. The Price of any Number of Grains will be as many Half-pence as there are Grains, therefore take half the Number of Grains for their Value in Pence.*

Hence, the Price of any Number of Ounces, Pennyweights, Grains, at 1 l. per *Ounce is known by Inspection, by calling the Ounces Pounds Sterling, the Pennyweights Shillings, and the Grains Half-pence.*

And the Price at any other Rate will be such Parts (or Multiple) of this Price, as the given Price per *Ounce is of* 1 l.

Ex. 1. What cost 36 oz. 17 dwt. 20 gr. at 20 *s.* *per* Ounce?

Answer 36 *l.* 17 *s.* 10 *d.*

Ex. 2. Requir'd the Amount of 36 oz. 16 dwt. $20\frac{1}{2}$ gr. at 4 *s.* 6 *d.* *per* dwt.

	l.	*s.*	*d.*	
	2)36	16	$10\frac{1}{4}$	at 1 *l.* *per* oz. or 1 *s.* *per* dwt.
			$\times 4$	
	147	7	5	
6 *d.* = $\frac{1}{2}$ *s.* =	18	8	$5\frac{1}{8}$	
Answer	165	15	$10\frac{1}{8}$	

From

From what has been ſaid, it follows, that whatever Number of Shillings (or Parts of a Shilling) 1 dwt. is ſold for, the ſame Number of Pounds (or the ſame Parts of a Pound) is the Price of 1 Ounce; and whatever Number of Half-pence one Grain is ſold for, the ſame Number of Shillings is the Value of one dwt. and the ſame Number of Pounds is the Value of one Ounce.

Ex. 3. What is the Value of 36 oz. 12 dwt. 15 gr. of Silver at 5 *s.* 5 *d.* *per* Ounce?

	l.	*s.*	*d.*	
	36	12	$7\frac{1}{2}$	at 1 *l.* *per* oz.
5 *s.* = $\frac{1}{4}$ =	9	3	$1\frac{7}{8}$	
5 *d.* = $\frac{1}{12}$ =	.	15	$3\frac{5}{32}$	
Anſwer	9	18	$5\frac{1}{32}$	

Ex. 4. What coſt 46 oz. 19 dwt. 18 gr. at 4 *s.* $7\frac{1}{2}$ *d.* (or 111 Half-pence) *per* Grain?

	l.	*s.*	*d.*
	46 —	19 —	9
	46.	19.	9.
	46..	19..	9..
	5106	2109	999
	+109	+83	3
		219|2	
Anſwer	5215	12	3

Or

3

Or thus, by Art. 24.

	l.	s.	d.		
	46	19	9	90 d.	900 d.
	469	17	6	19|7 s.	197|5 s.
	4698	15	0		
Answer	5215	12	3		

54.

Having the Price of 1 *given in any inferior Denominations, to find the Value of any assign'd Number (at the same Rate) in any proposed superior Denominations, by an immediate Change of the given Denominations.*

General Rule.

1st. Find how many Units of the highest given Denomination are equal in Value to a Unit of the highest Denomination sought, and make this Number (of Units) the Denominator of a Fraction, whose Numerator must be the given Number whose Value is sought; then reduce this Fraction to its lowest Terms, or to a mixt Number, if more convenient.

2d. Assume the highest Denomination in the given Price, as raised to the highest Denomination sought, and raise all the inferior Denominations in the same Proportion.

3d. Multiply the given Price (thus raised) by the Fraction found by the first Part of the Rule, the Product is the Value sought in the proposed Denominations.

Hence, when (in any Case) you call the Shillings Pounds, you must call the Pence 5 Groat-pieces, and the Farthings 5 Pence-pieces.

Note, *Any Number of 5 Groat-pieces are equal in Value to as many Shillings, and twice as many Groats (or as many 8 Pences.)*

Or thus.

Annex 0 *to the given Number of* 5 *Groat-pieces, and dividing by* 6, *the Quotient is Shillings, and the Remainder* 2 *Pences.*

Ex. Eight Five-Groat-pieces are equal to 8 *s.* and 8 times 8 *d.* (or 5 *s.* 4 *d.*) the Sum is 13 *s.* 4 *d.* the Value sought.

In the second Case, the 6th Part of 80 is 13, and 2 remains; that is, 13 *s.* and 2 Two-pences, or 13 *s.* 4 *d.* (perform'd in mind.)

Or thus.

6) 80

—

13 *s.* 4 *d.* the Value.

Case 1. *Having the Price of* 1 ℔. *given in Pence,* &c. *to find the Price of* 1 *Ct. in Pounds,* &c.

Rule. Call the given Pence Pounds, and the Farthings Crowns; and then divide 7 times this Sum by 5 and by 3, the last Quote is the Answer.

Ex. Requir'd the Amount of 112 ℔. in Pounds, &c. at $19\frac{1}{2}$ *d. per* ℔.

		l.	*s.*
the Price raised		19	10
			×7
	5)	136	10
	3)	27	6
	Answer	9	2

Or thus.

$19\frac{1}{2}$ Pence.

×7

5) $136\frac{1}{2}$

3) $27\frac{3}{10}$

Answer $9\frac{1}{10}$ *l.* as before.

Case

Case 2. *Having the Price of* 1 *given in Shillings*, &c. *to find the Price of* 112 *in Pounds*, &c.

Rule. Call the Shillings Pounds, call every Penny a 5 Groat-piece, and call every Farthing 5 Pence; and divide 28 times this Sum by 5, the Quotient is the Answer.

Ex. How many Pounds, *&c.* will 1 Ct. cost, at 17 *s.* $8\frac{1}{2}$ *d.* *per* lb.

	l.	*s.*	*d.*
given Price rais'd =	17	14	2
			× 4
	70	16	8
			× 7
5)	495	16	8
Answer	99	3	4

Or thus.

s.	*d.*	
17	$8\frac{1}{2}$	
	× $5\frac{3}{5}$	
88	$6\frac{1}{2}$	
3	$6\frac{1}{2}$	× 3, and add

Answer $99\frac{1}{6}$ *l.* as before.

Case 3. *Having the Price of* 1 *given in Shillings*, &c. *to find the Price of* 112 *in Guineas, Shillings*, &c.

Rule. Call the Shillings Guineas, for the Pence add as many Shillings, and as many 9 Pences, and for

for a Farthing add $5\frac{1}{4}$ Pence; and to 5 times this Sum add the third Part of the said Sum.

Ex. How many Guineas, &c. will 112 lb. cost, at 17 *s.* $8\frac{1}{2}$ *d.* *per* lb?

	G.	*s.*	*d.*
	17	14	$10\frac{1}{2}$ rais'd
			$\times 5\frac{1}{3}$
	88	11	$4\frac{1}{2}$
	5	18	$11\frac{1}{2}$
Answer	94	9	4

Or thus.

s.	*d.*
17	$8\frac{1}{2}$
	$\times 5\frac{1}{3}$
88	$6\frac{1}{2}$
5	$10\frac{5}{6}$

$$94 \quad 5\tfrac{1}{3})\ \overset{d.}{5\tfrac{1}{3}} \times 21 = \overset{s.}{9} \quad \overset{d.}{4})\ \overset{G.}{94} \quad \overset{s.}{9} \quad \overset{d.}{4}$$

To cast up Goods sold by the short Hundred (*viz.* 5 Score.)

Case 4. *When the Price is given in (or reduc'd to) Pence*, &c.

Rule. Call the Pence Pounds, and the Farthings Crowns; and divide 5 times this Sum by 12, the Quote is the Answer.

Ex.

Ex. What coſt one Hundred at $19\frac{1}{2}$ Pence each?

Thus.	Or thus.	Or thus.
l. *s.*	*l.* *s.* *d.*	*d.*
19 10		12) 1950
×5	12 . 2)19 10	
		s. *d.*
12) 97 10	9 15	2) 16|2 6
d.	—1 12 6	
Anſ. 8 2 6	Anſ. 8 2 6	Anſ. 8 *l.* 2 *s.* 6 *d.*

Caſe 5. *When the Price is given in Shillings*, &c.

Rule. If the Price is given in Shillings only, annex 0 thereto. But if given in Shillings and Pence, *&c.* to the Shillings annex 5 for 6 *d.* $2\frac{1}{2}$ for 3 *d.* and in like Proportion for any Number of Pence or Farthings: And eſteeming this Sum as Pounds, take the half thereof for the Anſwer.

Ex. At 13 *s.* or 13 *s.* 3 *d.* what coſt 100?

l.	*l.* *s.*
2) 130	2) 132 10
Anſw. 65 *l.* at 13 *s.*	Anſ. 66 *l.* 5 *s.* at 13 *s.* 3 *d.*

Rule 2. Call the Shillings Pounds, the Pence 5 Groat-pieces, and a Farthing 5 Pence; and take 5 times this Sum.

Ex. If 1 coſts 17 *s.* $8\frac{1}{2}$ *d.* what coſt 100?

	Or thus (by Caſe 6.)
l. *s.* *d.*	*s.* *d.*
17 14 2	1700 800
×5	70 50
Anſ. 88 10 10	Anwer 88 10 10

Caſe

Case 6. *When the Price is given in Pounds, Shillings*, &c.

Rule. To the given Number of Pounds, Shillings and Pence, annex 00 severally; and to this Sum add 25 (in the Place of Pence) for a Farthing.

Ex. What cost 100, if I pay 5*l.* 17*s.* $8\frac{1}{2}$*d.* for 1?

	l.	*s.*	*d.*
	500	1700	850
	+88	+70	10
		177|0	
Answer	588	10	10

To cast up Goods sold by the long Hundred (*viz.* of 6 Score.)

Case 7. *If the Price of* 1 *be given in Pence*, &c. *to find the Price of* 120.

Rule. Call the Pence Pounds, and the Farthings Crowns, and take half this Sum.

Ex. If 1 cost $7\frac{3}{4}$ *d.* what cost 120?

	l.	*s.*			Or thus.
2)	7	15		2)	$7\frac{3}{4}$ *d.*
Answer	3	17	6	Answer	$3\frac{7}{8}$ *l.*

Case 8. *If the Price of* 1 *be given in Shillings*, &c. *to find the Price of* 120 *in Pounds*, &c.

Rule. Call the given Shillings Pounds, the Pence 5 Groat-pieces, and a Farthing 5 Pence, and take 6 times this Sum.

Ex. What cost 120, if 1 costs 7 *s.* $9\frac{3}{4}$ *d.*?

l.	*s.*	*d.*	Or thus. *s.*	*d.*
7	16	3	7	$9\frac{3}{4}$
		$\times 6$		$\times 6$
Answer 46	17	6	46	$10\frac{1}{2}$

here $10\frac{1}{2}$ *d.* $\times 20 = 17$ *s.* 6 *d.*

To cast up Goods sold by the Thousand.

Case 9. *When the Price of* 1 *is given, to find that of* 1000.

Rule. Multiply the Pence, &c. that 1 costs by $4\frac{1}{6}$, and call the Pence in the Product Pounds, and the Farthings Crowns, or call the given Pence Pounds, and the Farthings Crowns, and multiply by $4\frac{1}{6}$.

Ex. 1000 Tennis Balls at $3\frac{1}{2}$ *d.* each.

$$\begin{array}{r} d. \\ 3\frac{1}{2} \\ \times 4\frac{1}{6} \\ \hline \end{array}$$

Answer $14\frac{7}{12}$ *l.*

Note, $\frac{7}{12}$ *l.* $= 11$ *s.* 8 *d.*

Or thus.

$$\begin{array}{rrr} & l. & s. \\ 6) & 3 & 10 \\ & & \times 4 \\ \hline & 14 & 0 \\ \times & 0 & 11 \quad 8 \\ \hline & 14 & 11 \quad 8 \end{array}$$

Or thus.

$$\begin{array}{r} 3 + 25 \\ \times 50 \\ \hline 12)\,175 \\ \hline \end{array}$$

	l.	*s.*	*d.*
Answ.	14	11	8.

Case

Case 10. *When the Price is given in Shillings*, &c.

Rule. Call the Shillings Pounds, the Pence 5 Groat-pieces, and the Farthings 5 Pence-pieces, and take 50 times this Sum.

Ex. What cost 1000, if I pay 37*s*. 9½*d*. for 1?

Or thus.

	l.	*s.*	*d.*			*s.*	
	37	15	10	20*d.*		37000	9000
				19|1*s.* by 50.		+791	+500
Ans.	1889	11	8		Answer	1889	11 8

Case 11. *When the Price is given in Pounds*, &c.

Rule. Annex 000 to every Denomination, and reduce the inferior Denominations to their proper Superiors.

Ex. If an Estate is rented at 38*l*. 13*s*. 6¾*d*. *per* Month, what will it amount to in 83 Years and 4 Months?

	l.	*s.*	*d.*	*q.*
	38000	1300|0	6000	3000
	+678	+56|2	+750	
Answer	38678	2	6	

Or thus (by Art. 24.)

	38	13	6¾	3000
				6750
Answer	38678	2	6	1356|2

To

To caſt up Goods ſold by the Groſs, or great Groſs.

Caſe 12. *Having the Price of* 1 *given, to find the Price of a Groſs; or the Price of a Dozen given, to find the Price of a great Groſs.*

Rule. The given Price being reduced to Pence and Farthings, call the Pence Pounds, and the Farthings, (if any) Crowns, and divide 3 times this Sum by 5, the Quote is the Anſwer.

Ex. If 1 coſt 4*d.* $3\frac{1}{2}$*q.* Farthings, what coſts a Groſs; or if 1 Dozen coſts 4*d.* $3\frac{1}{2}$*q.* what will a great Groſs coſt?

	l.	*s.*	*d.*
	4	17	6
			×3
5)	14	12	6
Anſwer	2	18	6

Or thus.

	d.	*q.*
	4	$3\frac{1}{2}$
		×3
5)	14	$2\frac{1}{2}$
	2	$3\frac{7}{10}$ ($3\frac{7}{10}$ Crowns = 18 *s.* 6 *d.*)

Caſe 13. *When the Price is given in Shillings,* &c.

Rule. Call the Shillings Pounds, the Pence 5 Groat-pieces, and a Farthing 5 Pence, and multiply this Sum by $7\frac{1}{2}$.

Ex. What will a great Groſs coſt at 11 *s.* $3\frac{1}{2}$ *d.* *per* Dozen?

	l.	*s.*	*d.*
5)	11	5	10
			×7
	79	0	10
	+2	5	2
Anſwer	81	6	..

The Reaſons of the Rules to all the foregoing Caſes of Art. 54.

Caſe 1. $\frac{112\text{ lb.}}{240\,d.} = \frac{7}{15}$ the common Multiplier (reciprocal $\frac{15}{7} = 2\frac{1}{7}$.)

Caſe 2. $\frac{112}{20\,s.} = \frac{28}{5} = 5\frac{3}{5}$ common Multiplier (reciprocal $\frac{5}{28}$.)

Caſe 3. $\frac{112}{21\,s.} = \frac{16}{3} = 5\frac{1}{3}$ common Multiplier (reciprocal $\frac{3}{16}$.)

Caſe 4. $\frac{100}{240\,d.} = \frac{5}{12}$ common Multiplier (reciprocal $\frac{12}{5} = 2\frac{2}{5}$.)

Caſe 5. $\frac{100}{20\,s.} = \frac{10}{2} = 5$ common Multiplier reciprocal $\frac{1}{5}$.)

Caſe 7. $\frac{120}{240\,d.} = \frac{1}{2}$ common Multiplier (reciprocal $\frac{2}{1}$.)

Caſe 8. $\frac{120}{20\,s.} = \frac{6}{1}$ common Multiplier (reciprocal $\frac{1}{6}$.)

Caſe 9. $\frac{1000}{240\,d.} = \frac{25}{6} = 4\frac{1}{6}$ common Multiplier (reciprocal $\frac{12}{50} = \frac{6}{25}$.)

Caſe 10. $\frac{1000}{20\,s.} = \frac{50}{1}$ common Multiplier (reciprocal $\frac{1}{50}$.)

Case 12. $\frac{144}{240}d. = \frac{3}{5}$ common Multiplier (reciprocal $\frac{5}{3} = 1\frac{2}{3}$.)

Case 13. $\frac{144}{20}s. = \frac{36}{5} = 7\frac{1}{5}$ common Multiplier (reciprocal $\frac{5}{36}$.)

55.

Having the Amount of any propoſed Number given in any ſuperior Denominations, to find the Price of 1 *in the proper inferior Denominations.*

Rule.

Aſſume the given Denominations as changed into thoſe requir'd; and multiply this Sum by the reciprocal Fraction of the correſponding (reverſe) Caſe in Art. 54.

Note, *This Rule (and all its Caſes) being juſt the contrary of Article* 54; *if that be well underſtood, there will be no Difficulty in this, therefore I ſhall omit giving particular Rules here, but ſhall give the Work of every Caſe.*

Note 2. *When you call Pounds Shillings, you muſt call the Shillings* 20*th Parts of a Shilling, and the Pence* 20*th Parts of a Penny,* &c. *And when you call Pounds Pence, you muſt call the odd Shillings and Pence ſuch a Fraction of a Penny as they are of a Pound,* &c. *that is, in whatever Proportion you decreaſe the higheſt Denomination given, you muſt decreaſe all the inferior Denominations given in the ſame Proportion.*

Caſe

Cafe 1. How many Pence will 1 ℔. coft, if I pay 99*l.* 3*s.* 4*d.* for 112 ℔?

d.
$99\frac{1}{6}$
$\times 2\frac{1}{7}$
$198\frac{2}{6}$
$+14\frac{1}{6}$
Anfwer $212\frac{1}{2}$ Pence.

Or thus.

l.	*s.*	*d.*
99	3	4
		$\times 2\frac{1}{7}$
198	6	8
14	3	4
212	10 (= $212\frac{10}{20}$ Pence.	

Cafe 2. How many Shillings, &c. will 1 ℔. coft, if I pay 99*l.* 3*s.* 4*d.* for 1 Ct?

	s.	*d.*
7)	99	2
4)	14	2
	3	$6\frac{1}{2}$
		$\times 5$
Anfwer	17	$8\frac{1}{2}$

Or thus.

	s.	*d.*
7)	99	2
4)	14	2
	+3	$6\frac{1}{2}$
Anfwer	17	$8\frac{1}{2}$

Cafe 3. If I pay 94 *G.* 9*s.* 4*d.* for 1 Ct. how many Shillings, &c. muft I pay for 1 ℔?

	s.	*d.*
	94	$5\frac{1}{3}$
		$\times 3$
4)	283	4
4)	70	10
Anfwer	17	$8\frac{1}{2}$

Or thus.

d.
$94\frac{4}{9}$
$\times 2\frac{1}{4}$
$188\frac{8}{9}$
$+23\frac{11}{18}$
Anfwer $212\frac{1}{2}$ Pence.

Cafe 4. How many Pence muft I pay for 1, if I pay 8 *l.* 2 *s.* 6 *d.* for 100?

d.
$8\frac{1}{8}$
$\times 12$

5) $97\frac{1}{2}$

Anfwer $19\frac{1}{2}$ Pence.

Cafe 5. If I pay as above for 100, how many Shillings and Pence will 1 coft?

s. *d.*
5) 8 $1\frac{1}{2}$

Anfwer 1 $7\frac{1}{2}$

Cafe 7. If 120 coft 3 *l.* 17 *s.* 6 *d.* how many Pence and Farthings will 1 coft?

d.
$3\frac{7}{8}$
$\times 2$

Anfwer $7\frac{3}{4}$ Pence.

Cafe 8. If 120 coft 46 *l.* 17 *s.* 6 *d.* how many Shillings, &c. will 1 coft?

s. *d.*
6) 46 $10\frac{1}{2}$

Anfwer 7 $9\frac{3}{4}$

Cafe

Case 9. If 1000 Tennis Balls cost 14 *l.* 11 *s.* 8 *d.* how many Pence will 1 cost?

l.	*s.*	*d.*
14	11	8
		× 12
5|0) 17|5	..	..

Answer $3\frac{25}{50}$ (or $3\frac{1}{2}$ P.)

Or thus.

l.	*s.*	*d.*
14	11	8
		× 6
5) 87	10	
5) 17	10	
3	10 (or $3\frac{10}{20}$ *d.*)	

Case 10. How many Shillings, &c. will 1 cost, at the Rate of 38678 *l.* 2 *s.* 6 *d.* *per* Thousand?

	s.	*d.*
5)	38678	$1\frac{1}{2}$
10)	7735	$7\frac{1}{2}$
Answer	773	$6\frac{3}{4}$ or 38 *l.* 13 *s.* $6\frac{3}{4}$ *d.*

Or thus.

s.

5\|0) 3867\|$8\frac{1}{8}$

Answer $773\frac{9}{16}$.

One

. One Question of Practice solved twenty Ways, to shew the different Methods of Solution, and varying the Parts.

Example. What cost 573 Ct. 3 q. 22 ℔. at 4 *l.* 17 *s.* 6 *d.* *per* Ct?

(1.)

		Ct.	q.	℔.	
		573	3	22	
		×4	17	6	
		2292			
10*s.*	= $\frac{1}{2}$ =	286	10*s.*		
5*s.*	= $\frac{1}{2}$ =	143	5		
2*s.* 6*d.*	= $\frac{1}{2}$ =	71	12	6*d.*	
2 q.	= $\frac{1}{2}$ =	- 2	8	9	
1 q.	= $\frac{1}{2}$ =	- 1	4	$4\frac{1}{2}$	= 28
14 ℔.	= $\frac{1}{2}$ =	- .	12	$2\frac{1}{4}$	= 14
7 ℔.	= $\frac{1}{2}$ =	- -	6	$1\frac{1}{8}$	= 7
1 ℔.	= $\frac{1}{7}$ =	- - .		$10\frac{25}{56}$	= 25
					56) 74 (1
Answer		2797	19	$9\frac{9}{28}$	$\frac{18}{56}$ | $\frac{9}{28}$

(2.)

(2.)

		l.	s.	d.		
		4	17	6		
			×	573		
		14	12	6		
		341	5	0		
		2437	10	0		
2 q. = $\frac{1}{2}$ =	-	2	8	9		
1 q. = $\frac{1}{2}$ =	-	1	4	$4\frac{1}{2}$	=	28
14 lb. = $\frac{1}{2}$ =	-	.	12	$2\frac{1}{4}$	=	14
7 lb. = $\frac{1}{2}$ =	-	-	6	$1\frac{1}{8}$	=	7
1 lb. = $\frac{1}{7}$ =	-	-	.	$10\frac{25}{56}$	=	25
						74 (1
Anſwer		2797	19	$9\frac{9}{28}$		$\frac{18}{56}$ | $\frac{9}{28}$

Art. 24.

60
2|5
600
75|0

Theſe are the common Methods of Solution, (excepting the marginal Multiplication) the following are not ſo common.

(3.)

7 . 6) 22

	l.	s.	d.	
		3	8	
		15	$3\frac{1}{7}$	
	573	18	$11\frac{1}{7}$	by Art. 51.
2 s. = $\frac{1}{10}$ =	57	7	$10\frac{5}{7}$	
			× 9	
2 s. × 9 = 18 s. =	516	11	$0\frac{3}{7}$	
6 d. = $\frac{1}{4}$ =	–14	6	$11\frac{19}{28}$	
at 17 s. 6 d. =	502	4	$0\frac{3}{4}$	
at 4 l. =	2295	15	$8\frac{4}{7}$	
Anſwer	2792	19	$9\frac{9}{28}$	

(4.)

(4.)

	l.	s.	d.
	573	18	$11\frac{1}{7}$
2 s. = $\frac{1}{10}$ =	57	7	$10\frac{5}{7}$
2 s.×8 = 16 s. =	459	3	$1\frac{5}{7}$
1 s. = $\frac{1}{2}$ =	28	13	$11\frac{5}{14}$
6 d. = $\frac{1}{2}$ =	14	6	$11\frac{19}{28}$
Product by 4 =	2295	15	$8\frac{4}{7}$
Anſwer	2797	19	$9\frac{9}{28}$

(5.)

	l.	s.	d.
	573	18	$11\frac{1}{7}$
Product by 3 =	1721	16	$9\frac{3}{7}$
10 s. = $\frac{1}{2}$ =	286	19	$5\frac{4}{7}$
6 s. 8 d. = $\frac{1}{3}$ =	191	6	$3\frac{5}{7}$
10 d. = $\frac{1}{8}$ =	23	18	$3\frac{13}{28}$
Anſwer	2797	19	$9\frac{9}{28}$

(6.)

	l.	s.	d.	
8 . 2)	5730	180	$110\frac{10}{7}$	× 5 — $\frac{1}{8}$
	2865	90	$55\frac{5}{7}$	
	—71	14	$10\frac{11}{28}$	
	2794	7 | 6	$45\frac{9}{28}$	
	3	| 3		
Anſwer	2797	19	$9\frac{9}{28}$	

(7.)

	l.	*s.*	*d.*	
	573	18	$11\frac{1}{7}$	$\times \frac{39}{8}$
			$\times 39$	
	5165	10	$4\frac{2}{7}$	
	17218	7	$10\frac{2}{7}$	7|30
				94
8)	22383	18	$2\frac{4}{7}$	167
Answer	2797	19	$9\frac{9}{28}$	

(8.)

l.	*s.*	*d.*	
573	18	$11\frac{1}{7}$	$\times 48\frac{3}{4}$
		$\times 8$	
4591	11	$5\frac{1}{7}$	
22957	17	$1\frac{5}{7}$	40
286	19	$5\frac{4}{7}$	85
143	9	$8\frac{11}{14}$	15|7
l. 2797 | 9 $\times 2$	1 | 7 $\times 12$	$9\frac{3}{14}$	
19 *s.*	$9\frac{9}{28}$ *d.*		

(9.)

	l.	*s.*	*d.*	
8)	573	18	$11\frac{1}{7}$	$\times 5 - \frac{1}{8}$
			$\times 5$	
	2869	14	$7\frac{5}{7}$	
	-71	14	$10\frac{11}{28}$	
Answer	2797	19	$9\frac{9}{28}$	

(10.)

(10.)

	l.	*s.*	*d.*	
	573	18	$11\frac{1}{7}$	$\times 4+\frac{7}{8}$
Product by 3 =	1721	16	$9\frac{3}{7}$	
	+ 71	14	$10\frac{11}{28}$	× 7 and add.
Answer	2797	19	$9\frac{9}{28}$	

(11.)

by Art. 47.

$4 \quad 17\frac{1}{2}$

$2\ )\ 97\frac{1}{2}$

$48\frac{3}{4}$

l.	*s.*	*d.*	*q.*
57	7	10	$2\frac{6}{7}$
			$\times 48\frac{3}{4}$
459	3	1	$2\frac{6}{7}$
2295	15	8	$2\frac{2}{7}$
28	13	11	$1\frac{3}{7}$
14	6	11	$2\frac{5}{7}$
2797	19	9	$1\frac{2}{7}$

$7\ )\ 22$

$3\frac{1}{7}$

$-\ 18\frac{6}{7}\ f.$

$7\ )\ 30$

34 *q.*

68 *d.*

11|5 *s.*

(12.)

	l.	*s.*	*d.*	*q.*
	57	7	10	$2\frac{6}{7}$
				× 12
	688	14	8	$2\frac{2}{7}$
				× 4
	2754	18	10	$1\frac{1}{7}$
	28	13	11	$1\frac{3}{7}$
	14	6	11	$2\frac{5}{7}$
Answer	2797	19	9	$1\frac{2}{7}$

(13.)

(13.)

	l.	s.	d.	q.	
	4) 57	7	10	$2\frac{6}{7}$	$\times \frac{195}{4}$
7) 500	14	6	11	$2\frac{5}{7}$	
271				× 195	7) 30
1167					·04
69|7	71	14	10	$1\frac{4}{7}$	91
	1291	7	7	$0\frac{2}{7}$	2|7
	1434	17	3	$3\frac{3}{7}$	
	2797	19	9	$1\frac{2}{7}$	

(14.)

	l.	s.	d.	q.	
× 200 — 5	57	7	10	$2\frac{6}{7}$	500
	11478	18	6	$3\frac{3}{7}$	171
	—286	19	5	$2\frac{2}{7}$	942
					157|8
4)	11191	19	1	$1\frac{1}{7}$	
Anſwer	2797	19	9	$1\frac{2}{7}$	

Having ſhewed a ſufficient Variety of Methods, by vulgar Arithmetic, I ſhall now ſhew how all Caſes of Practice may be ſolved decimally.

Rule. Reduce the inferior Denominations of the given Price to a Decimal of the Superior, and alſo the inferior Denominations of the given Number whoſe Price is ſought; then the Product of theſe two given Terms (found by Multiplication of Decimals) is the Anſwer, in the ſame Name as the higheſt Denomination of the given Price.

(15.)

(15.)

Ex.	3 q. = ,75 by the common Rule.		
	14 lb. = $\frac{1}{6}$ = ,125		
	7 lb. = $\frac{1}{2}$ = ,0625		
	1 lb. = $\frac{1}{7}$ = ,008928, &c.		

Ct. q. lb.

573 3 22 = 573,946428

4 *l.* 17 *s.* 6 *d.* = . . × 4,875

8) 7,0
,875 *l.*

2869732140
4017624996
4591571424
2295785712

l. 2797,9888365|00 useless.
× 20

s. 19,77673|00
× 12

d. 9,32076
× 4

q. 1,28304

(16.)

(16.)

$$
\begin{array}{lr}
 & 4{,}875 \\
 & \times\ 573 \\
\hline
 & 14625 \\
 & 34125\cdot \\
 & 2437{,}5\cdot\cdot \\
2\ q. = \tfrac{1}{2} = - - & 2{,}4375 \\
1\ q. = \tfrac{1}{2} = - - & 1{,}21875 \\
14\ lb. = \tfrac{1}{2} = - - & {,}609375 \\
7\ lb. = \tfrac{1}{2} = - - & {,}3046875 \\
1\ lb. = \tfrac{1}{7} = - - & {,}0435267 \\
\hline
\text{Anſwer} & 2797{,}9888392
\end{array}
$$

(17.)

$$
\begin{array}{rl}
57{,}3946428 & \text{at } 2s. \\
\times\ 8 & \\
\hline
459{,}1571424 & \\
\times\ 6 & \\
\hline
2754{,}9428544 & \\
28{,}6973214 & \\
14{,}3486607 & \\
\hline
\text{Anſwer } 2797{,}9888365 &
\end{array}
$$

(18.)

4) 57,3,9464
×9

516,55176
− 14,34866

502,20310
Product by 4 = 2295,7856

Anfwer 2797,9887

(19.)

8) 573,946428
×5

2869,732140
− 71,7433035

Anfwer 2797,9888365

(20.)

8 . 2) 573'9,46428
2869,73214
− 71,74330

Anfwer 2797,98884

By

By the 15th Operation it appears, that if Practice be solved decimally by the common Rules, the Operation will, in many Cases, be more prolix and tedious than by vulgar Arithmetic; therefore to facilitate all decimal Operations, I shall shew the most expeditious Methods of turning all inferior Denominations into Decimals, and *vice versa*. See Art. 70, &c. I have been thus particular in this Example to open (at once) the Understanding of the young Accomptant, by shewing him at one View how unlimited the Methods of calculating by this useful Rule are.

And I dare affirm, that though some Persons have wrote whole Books (and some of them larger than my two Volumes) upon this one Rule (of Practice) only; yet it will appear to a careful Examiner and competent Judge, that they have not shewn more Variety in general Cases than are to be found in the Solutions of this one Question. And for short Methods of calculating the Prices of particular Quantities, I flatter myself that the foregoing Parts of this Rule will be satisfactory: It is true, I have given no more Questions in this Rule than were necessary to illustrate the particular Rules, having given a sufficient Number of Questions for Exercise in my first Volume; and because I think that to swell a Book to an enormous Size by inserting a huge Number of simple and similar Questions, tends rather to tire the Reader's Patience, and discourage the young Student from entering so large a Field, than to the Improvement of his Knowledge, and especially when he finds it to be no more than Ditto *per* Ditto.

To calculate the moſt uſeful Caſes of

TRADE IN MIND.

56.

To bring Pounds Sterling into Guineas, in Mind.

Rule. Divide the given Pounds by 21, and ſubtract the Quote from the given Number of Pounds, eſteem'd as Guineas, the Remainder is the Value in Guineas.

Note, *Whatever remains in dividing by* 21, *are ſo many Shillings.*

	l.	*l.*		*l.*	*s.*	*d.*
Ex. Reduce	714 – –	and 57 – –		and 964	13	4
	21)	21)		21)		
	—34	—2	15*s.*	—45	19	
into Guineas,	*G.*	*G.*	*s.*	*G.*	*s.*	*d.*
&c.	Anſ. 680	Anſ. 54	6	Anſ. 918	15	4

Now to divide by 21 (in Mind) muſt be very eaſy, ſince the Product of 21 by any Figure may he had in Mind, by only imagining the multiplying Figure annexed to the Double thereof, and then for the next Step of the Diviſion, imagine the Remainder prefixed before the next Figure of the Dividend, for a new Dividend, as in dividing by a ſingle Figure.

In the firſt Example, 21 is contain'd in 71 three times, which (3) I put down, and the Remainder

(8)

(8) I ſuppoſe prefixed before the next Figure (4) which makes 84, in which there are 4 times 21; therefore the complete Quote is 34, which taken from 714, leaves 680 Guineas.

Caſe 2. *To reduce Guineas to Pounds, in Mind.*

Rule. Eſteem the firſt (or right-hand) Figure of the given Guineas as Shillings (to which add ten if the ſecond Figure be an odd Number, and ſubtracting 1 from the ſecond Figure) eſteem half the Remainder of the Guineas as ſo many Pounds; which Pounds (and Shillings if there are any) added to the given Sum, gives the Anſwer.

	G.		*G.* *s.* *d.*	
Ex. Reduce	795	- - - - and	378 14 9	into
Pounds, *&c.*	+ 39 15 *s.*		+ 18 18	
Anſwer	*l.* 834 15 *s.*	Anſw.	*l.* 397 12 *s.* 9 *d.*	

And that both theſe Caſes are eaſily and expeditiouſly performed in Mind, will (upon Trial) be evident to any tolerable Accomptant.

57.

To caſt up Goods ſold by the hundred Weight, or 112 ℔. *in Mind.*

Caſe 1. *Having the Price of* 1 ℔. *given, to find the Price of* 1 *Ct.*

Rule 1. As many 2 Shilling-pieces, and as many Groats as 1 ℔. coſts Farthings, will be the Price of 1 Ct.

Ex. At 3*s.* $6\frac{3}{4}$*d. per* ℔. what will 1 Ct. coſt?

The given Price reduc'd to Farthings make 171; therefore 171 Two-ſhilling-pieces, and 171 Groats (or 19*l.* 19*s.*) is the Anſwer.

Rule 2. Double the right-hand Figure of the given Price in Farthings, for Shillings, the reſt eſteem as Pounds; and to this Sum add the 6th Part thereof.

Ex. Double the right-hand Figure (of 171) is 2, which I call 2*s.* and the 17 remaining I eſteem as 17*l.* and the 6th Part of 17*l.* 2*s.* is 2*l.* 17*s.* the Total 19*l.* 19*s.* as before.

Rule 3. From half as many Pounds as 1 ℔. coſts Pence (allowing half a Crown for a Farthing) ſubtract twice as many Groats (allowing 2 Pence for a Farthing) the Remainder is the Anſwer in Pounds, &c.

Ex. At 7*s.* $9\frac{1}{2}$*d. per* ℔. what will 1 Ct. coſt?

In the given Price there are 93 Pence, which I eſteem as Pounds, the half is 46*l.* 10*s.* to which adding 5*s.* for the Half-penny, the Sum is 46*l.* 15*s.* from which ſubtracting $93\frac{1}{2}$ Eight-pences (or 3*l.* 2*s.* 4*d.*) the Remainder is 43*l.* 12*s.* 8*d.* the Anſwer.

Note, *Eight-pences are eaſily brought into Pounds, &c. in Mind, thus: Eſteem the right-hand Figure as Eight-pences, and take one third of the reſt as Pounds.*

So in the above $93\frac{1}{2}$, the 3d Part of 9 is 3*l.* and 8 times $3\frac{1}{2}$ Pence is 2*s.* 4*d.* Note, *When the given Price is large, this is the beſt Rule.*

Rule 4. Take as many 9*s.* Pieces, and as many Groats, as 1 ℔. coſts Pence, adding thereto 2*s.* 4*d.* for a Farthing.

Ex. At $5\frac{1}{4}$*d. per* ℔. what will 1 Ct. coſt?

5 times 9*s.* is 45*s.* and 5 Groats, make 46*s.* 8*d.* to which adding 2*s.* 4*d.* for the Farthing, the Anſwer is 49*s.*—*Apply this Rule when the Price is ſmall.*

Rule 5. From as many Half-crowns as 1 ℔. coſts Farthings, take as many Two-pences.

And thus may the Accomptant pleaſe himſelf in any of theſe Rules (applying that which he likes beſt)

best) when the Price is given in (or reduc'd to) Pence or Farthings. But I would recommend the following Rule, when the Price is large, or given in Pounds or Shillings.

Rule 6. Take as many 5 *l.* Pieces, and as many 12 *s.* Pieces as 1 ℔. costs Shillings, for the Price sought.

Note, 12 s. *Pieces are easily reduced to Pounds, in Mind, thus: Multiply the given Number (of* 12 s. *Pieces) by* 6, *esteeming double the right-hand Figure of the Product as Shillings, and the rest as Pounds.*

Ex. What cost 1 Ct. at 3 *l.* 17 *s. per* ℔?

The given Price reduced to Shillings, make 77, then 5 times 77 *l.* is 385 *l.* and 6 times 77 is 462, which I esteem as 46 *l.* 4 *s.* (doubling the 2 for Shillings) to which adding the 385 *l.* (formerly found) we have 431 *l.* 4 *s.* the Answer.

Had there been Pence and Farthings given also, I would have found for them by some of the former Rules, and added this Price: or the Price for odd Farthings may be found in consequence of the 6th Rule, *viz.* add such Parts of 5 *l.* 12 *s.* as the odd Pence, &c. is of a Shilling.

Ex. At 6 Pence *per* ℔. 1 Ct. will cost the ½ of 5 *l.* 12 *s.* the Price of 1 Ct. at 3 *d. per* ℔. will be the 4th Part of 5 *l.* 12 *s.* equal 1 *l.* 8 *s.* the Price at 1 Penny will be the 12th Part of 5 *l.* 12 *s.* or 9 *s.* 4 *d.* and in like manner for any other Price under a Shilling.

Case 2. *Having the Price of* 1 *Ct. given, to find the Price of* 1 ℔.

Rule. To the given Number of Pounds annex 0 if there are no Shillings given (or if the odd Money is less than 2 *s.*) But if there are Shillings given, then to the Pounds annex half the greatest even Number in the given Shillings (rejecting the rest.) Then from the Pounds thus increased subtract the 7th Part thereof

thereof (rejecting the Remainder of the Division) this Remainder is the Anſwer in Farthings.

Note, *If the Price is given in Shillings, 'tis evident by the above Rule, that the 7th Part of half theſe Shillings ſubtracted therefrom, will be the Anſwer in Farthings.*

Ex. 1. At 8*l.* *per* Ct. what will 1 ℔ coſt?

A 0 annexed to 8 makes 80, the 7th Part of which is 11 (rejecting the 3 over, as *per* Rule) therefore if from 80 we take 11, the Remainder 69 is the Anſwer in Farthings; and this does not err half a Farthing; nor will the Rule ever err a Farthing.

Ex. 2. If 112 ℔. coſt 29*l.* 17*s.* 6*d.* what will 1 ℔. coſt?

The Half of the greateſt even Number in 17 *s.* is 8, which annexed to the given Pounds, make 298, and the 7th Part thereof (rejecting the Remainder 2) is 42; which ſubtracted from 298 leaves 256 Farthings, the Anſwer.

Ex. 3. At 32*s.* 4*d.* *per* Ct. what will 1 ℔. coſt?

The 7th Part of 16*s.* (rejecting the Remainder) is 2, which taken from 16 leaves 14 Farthings, the Anſwer.

And this Rule will never err a Farthing in the Anſwer; but if you chuſe to give the Anſwer exact in all Caſes, apply this

Rule 2. To the given Number of Pounds annex half the greateſt even Number in the given Shillings, and to this whole Number annex ſuch a Fraction as half the reſt of the given Price (or odd Shillings and Pence, &c.) is of one Shilling; the 7th Part of this mixed Number ſubtracted from ſaid Number, leaves the Anſwer in Farthings, and Parts of a Farthing.

Ex. Queſtion as *per* Ex. 2. $\Big\}\ 7)\,298\frac{3}{4}\ \Big\{$ (the $\frac{1}{2}$ of 1 *s.* 6*d.* being $\frac{3}{4}$ of 1*s.*)

$$-42\tfrac{19}{28}$$

Anſwer $256\frac{1}{14}$ Farthings.

Here

Here we see the Error by the first Rule is only the 14th Part of a Farthing, and therefore not worth calculating for in Practice. And having found the Price of 1 ℔. by this Rule, the Price of any given Number of Pounds may be found, by multiplying by the Number of Pounds.

I have been thus large upon these two Cases, because they are the most useful in Trade.

58.

To cast up Goods sold by the short Hundred (viz. *of* 5 *Score*) *in Mind.*

Case 1. *Having the Price of one given, to find the Price of one Hundred.*

Rule 1. Take as many 2 *s.* Pieces, and as many Pence as one costs Farthings.

Ex. At $19\frac{1}{2}$ *d.* each, what will one Hundred cost?

In $19\frac{1}{2}$ *d.* there are 78 Farthings, which esteemed as 2 *s.* Pieces, I bring into Pounds, &c. by doubling the right-hand Figure (8) for Shillings, and taking the rest (7) as Pounds, then to this Sum (7 *l.* 16 *s.*) I add 78 Pence (or 6 *s.* 6 *d.*) the Total (8 *l.* 2 *s.* 6 *d.*) is the Price sought.

Rule 2. Multiply the Pence that one costs, by 4, esteeming double the first Figure of the Product as Shillings, and the rest of the Product as Pounds; then to this Sum add one third as many Shillings as one costs Pence.

Note, *Add* 2 s. 1 d. *for a Farthing.*

Ex. At $37\frac{1}{4}$ *d.* each, what will one Hundred cost?

4 times 7 is 28; then doubling the 8 for Shillings, I have 2 to carry (for 28); 4 times 3 is 12, and 2 carried is 14, that is 14 *l.* 16 *s.* to which adding the third Part of 37 *s.* (*viz.* 12 *s.* 4 *d.*) the Sum 15 *l.* 8 *s.* 4 *d.* is the Price at 37 Pence, therefore for the odd

odd Farthing add 2 *s.* 1 *d.* and the Anſwer is 15 *l.* 10 *s.* 5 *d.*

To the given Pounds annex 5 times as many Pounds as there are Shillings given, (but for one Shilling annex 05) and proportionably for any Price under a Shilling.

Note, 5 *times the Number of Shillings, is the Price at that Number of Shillings; and for the Price at any Number of Pounds annex* 00.

Ex. At 4 *l.* 13 *s.* for one, what will one Hundred coſt?

For the Price at 13 *s.* I take 5 times 13 *l.* (*viz.* 65 *l.*) before which prefixing 4 *l.* makes 465 *l.* the Price ſought. And had the Price been 4 *l.* 13 *s.* 6 *d.* I would have added the half of 5 *l.* for the Price at 6 *d.* becauſe 6 *d.* is $\frac{1}{2}$ a Shilling: And in like manner, for any Number of Pence or Farthings, take ſuch Parts of 5 *l.* as they are of one Shilling.

Caſe 2. *Having the Price of one Hundred (or 5 Score) given, to find the Price of one.*

Rule. Reckon the Figure in the Hundred's Place of any Denomination, as ſo many Units of that Denomination, and all to the left thereof accordingly; and the remaining two Figures (to the right) as ſo many hundredth Parts of that Denomination.

Ex. If 1 Hundred coſt 465 *l.* what will one coſt?

The 4 in the Hundred's Place I reckon 4 *l.* and reducing the remaining 65 *l.* to Shillings, they make 1300, that is 13 *s.* (rejecting the 2 right-hand Places) by the Rule; and ſo the Anſwer is 4 *l.* 13 *s.*

Ex. 2. At 33 *l.* 0 *s.* 10 *d. per* Hundred, what coſt one?

The Work as *per* Margin (which is eaſily perform'd in Mind) gives 6 *s.* 7 *d.* $1\frac{1}{5}$ *q.* for the Anſwer.

	l.	
	33	
s. 6	60	
d. 7	30	
q. 1	$\frac{20}{100}$	$\frac{1}{5}$

Hence

Hence 'tis plain, that this Rule is the ſame as that for finding the Intereſt of any given Sum for 1 Year, at 1 *per Cent. per Ann.* ſimple Intereſt.

59.

To caſt up Goods ſold by the long Hundred (viz *of* 6 *Score*) *in Mind.*

Caſe 1. *Having the Price of one given, to find the Price of one Hundred.*

Rule. Take half as many Pounds as one coſts Pence, adding half a Crown for a Farthing.

Ex. What will one Hundred of Deals come to at $13\frac{3}{4}$ *d.* each?

The half of 13 is $6\frac{1}{2}$, that is 6 *l.* 10 *s.* to which adding 3 Half-crowns for the 3 Farthings, the Sum 6 *l.* 17 *s.* 6 *d.* is the Anſwer.

Caſe 2. *Having the Price of one Hundred given, to find the Price of one.*

Rule. Eſteem double the given Number of Pounds (adding 1 thereto for ten Shillings) as ſo many Pence; to which adding a Farthing for every Half-crown in the Remainder of the given Price, the Sum is the Anſwer.

Ex. If I pay 18 *l.* 16 *s.* 3 *d.* for a Hundred of Deals, what is the Price of one Deal?

To the Double of 18 adding 1 (for the 10 in 16 *s.*) we have 37, the Number of Pence; to which adding $2\frac{1}{2}$ Farthings (for the $2\frac{1}{2}$ Half-crowns in the remaining 6 *s.* 3 *d.*) we have 3 *s.* 1 *d.* $2\frac{1}{2}$ *q.* the Price ſought.

60.

To cast up Goods sold by the Thousand, in Mind.

Case 1. *Having the Price of one given, to find the Price of a Thousand.*

Rule 1. To as many Pounds as one costs Farthings, add as many Ten-pences.

Rule 2. From as many Guineas as one costs Farthings, take as many Two-pences.

Note, *Two-pences are brought into Shillings by dividing by 6, the Quote being Shillings, and the Remainder Two-pences.*

Ex. What will a Thousand of Lemons cost at 7 Farthings each?

By Rule 1. Ans. 7 *l.* and 70 *d.* that is, 7*l.* 5*s.* 10*d.*

Ex. 2. What cost a Thousand, at $14\frac{3}{4}$ *d.* (or 59 Farthings) for one?

By Rule 2. From 59 Guineas (or 59 *l.* 59 *s.*) take 59 Two-pences (or 9 *s.* 10 *d.*) the Remainder 61 *l.* 9 *s.* 2 *d.* is the Answer.

Case 2. *Having the Price of a Thousand given, to find the Price of one.*

Rule. To 4 times all the Figures to the left of the two right-hand Figures in the given Number of Pounds, add 1 for every 25 in the two right-hand Figures; this Sum subtracted from the given Number of Pounds, leaves the Answer in Farthings.

Ex. At 564 *l.* 18 *s.* 9 *d. per* Thousand, what is the Price of one?

To 4 times 5, I add 2, for the two Twenty-fives in 64 (rejecting all the rest) this Sum (22) taken from 564 leaves 542, the Answer in Farthings.

Note, *You need not regard the given Shillings and Pence in any Caſe; neither need you make any Allowance (or Deduction) for leſs than* 25 l.

5'64
×4 . .
—22
——
Anſwer 542 Farthings.

Ex. 2. At 24 *l.* 19 *s.* 11$\frac{3}{4}$ *d. per* thouſand, what will one coſt?

Anſwer 24 Farthings.—Here, though I make no Deduction (the given Price being leſs 25 *l.*) the Error is only the thouſandth Part of a Penny in the Price of a thouſand. But if you chuſe the Anſwer exact in all Caſes, apply this

Rule 2. Find the Intereſt of the given Price at 4 *per Cent.* and from the given Price ſubtract ſaid Intereſt, eſteeming the Pounds in the Remainder as Farthings, and the reſt in the ſame Proportion.

Thus, in the 1ſt Ex.	564	18	9
Intereſt at 4	—22	11	11$\frac{2}{5}$
Anſwer	542	6	9$\frac{3}{5}$ eſteeming as *per* Rule.

Here the exact Anſwer is 542 Farthings, and $\frac{51}{750}$ (or $\frac{17}{250}$) Parts of a Farthing.

61.

To caſt up Liquors, &c. *ſold by the Gallon, Ton, or Hogſhead, in Mind.*

Caſe 1. *Having the Price of a Gallon given, to find the Price of a Ton (or a Hogſhead).*

Rule. A Ton will coſt as many Guineas, as a Gallon coſts Pence, adding 5 *s.* 3 *d.* for a Farthing. —Then, if you want the Price of a Hhd, take the 4th Part of the Price thus found.

Ex.

Ex. Brandy at 6 *s.* $10\frac{3}{4}$ *d.* *per* Gallon, what cost one Ton?

In the given Price there are 82 Pence, which I reckon as Guineas, and for the 3 Farthings, I add 3 times 5 *s.* 3 *d.* the Sum 82 Guineas, and 15 *s.* 9 *d.* is the Price of a Ton; the 4th Part of which is the Price of a Hogshead.

Case 2. *Having the Price of a Ton (or a Hogshead) given, to find the Price of a Gallon.*

Rule. For every Guinea in the Price of a Ton reckon a Penny, and for every 5 *s.* 3 *d.* in the Remainder (if any) reckon a Farthing.

Ex. At what Rate *per* Gallon do I buy Wine, if I pay 97 *l.* 5 *s.* $1\frac{1}{2}$ *d.* *per* Ton?

The given Price reduced to Guineas (by Art. 56.) make 92, which I call 92 Pence, and for the Half-guinea in the Remainder (13 *s.* $1\frac{1}{2}$ *d.*) I reckon $\frac{1}{2}$ a Penny; there yet remains 2 *s.* $7\frac{1}{2}$ *d.* (equal the $\frac{1}{2}$ of 5 *s.* 3 *d.*) for which I reckon $\frac{1}{2}$ a Farthing; the whole is $92\frac{1}{2}$ Pence, and $\frac{1}{2}$ a Farthing, the Price of a Gallon exactly.

And had the Price of a Hogshead been given, you might have multiplied it by 4 (which would be the Price of a Ton) and then proceed as above for the Price of a Gallon.

62.

To cast up Goods sold by the Gross, or great Gross, in Mind.

Case 1. *Having the Price of one given, to find the Price of a Gross; or having the Price of a Dozen given, to find that of the great Gross.*

Rule 1. Multiply the given Price reduc'd to Pence by 6, esteeming double the first Figure of the Product

duct as Shillings, the rest as Pounds; to which add 3 *s.* for a Farthing (if any are given) you have the Price sought.

Rule 2. The given Price being reduced to Pence, double the right-hand Figure thereof for Shillings, and esteem the rest as Pounds; to this Sum add half as many Pounds as there are Pence in the given Price (and also 3 *s.* for each given Farthing) the Total is the Price sought.

Ex. At 3 *s.* $11\frac{1}{2}$ *d.* (or $47\frac{1}{2}$ Pence) *per* Dozen, what will a great Grofs of gilt Buttons come to — or at $47\frac{1}{2}$ Pence for one, what will a Grofs cost?

By Rule 1. 6 times $\frac{1}{2}$ is 3 to carry, and 6 times 7 is 42 and 3 carried is 45 (the 5 doubled is 10) that is 10 *s.* to put down, and 4 to carry to the Pounds; then 6 times 4 is 24, and 4 carried is 28, therefore the Answer is 28 *l.* 10 *s.* — Note, *you may multiply the Fraction by* 6 *(as above) or add* 3 s. *for a Farthing.*

By Rule 2. The first Figure of the Pence doubled is 14 *s.* which with the rest makes 4 *l.* 14 *s.* to which adding the half of 47 *l.* and also 6 *s.* for the 2 Farthings, we have 28 *l.* 10 *s.* as before.

Case 2. *Having the Price of a great Grofs given, to find the Price of a Dozen; or having the Price of a Grofs given, to find the Price of one.*

Rule. For every 12 *s.* in the given Price reckon a Penny; and for every 3 *s.* in the Remainder reckon a Farthing.

Ex. What will a Dozen cost at 4 *l.* 10 *s.* the great Grofs?

In 4 *l.* 10 *s.* there are 7 Twelve-shilling-pieces (and 6 *s.* over) for which I reckon 7 Pence; and for the 6 *s.* over, I reckon a $\frac{1}{2}$ Penny, therefore the Answer is $7\frac{1}{2}$ Pence.

Or

Or to the Pounds annex half the Shillings, and eſteeming this Sum as ſo many Pence, the 6th Part thereof is the Anſwer.

Ex. At 7 *l.* 9 *s.* 6 *d.* $\quad 6\,)\,\overset{d.}{74\frac{3}{4}}$

Anſwer $12\frac{11}{24}$ Pence.

63.

To caſt up Goods ſold by the Chaldron and Buſhel, in Mind.

Caſe 1. *Having the Price of a Buſhel of Coals given, to find the Price of a Chaldron.*

Rule. Take triple as many Shillings as a Buſhel coſts Pence, adding 9 *d.* for a Farthing.

Ex. Coals at $14\frac{1}{2}$ *d.* *per* Buſhel, what are they a Chaldron?

3 times 14 is 42 Shillings, which is the Price at 14 *d.* therefore add 18 Pence for the 2 Farthings, the whole is 43 *s.* 6 *d.* the Anſwer.

Caſe 2. *Having the Price of a Chaldron of Coals given, to find the Price of a Buſhel.*

Rule. For every 3 *s.* in the given Price reckon a Penny; to which add a Farthing for every 9 Pence in the Remainder.

Ex. How much *per* Buſhel is Coals at 51 *s.* 9 *d.* *per* Chaldron?

The third Part of 51 is 17, which I call 17 *d.* and adding a Farthing for the 9 Pence, the Sum is $17\frac{1}{4}$ Pence, the Anſwer.

64.

64.

To cast up Goods or Metals, sold by Troy Weight, in Mind. See Art. 53. Case 3.

65.

To cast up Goods generally when the Price (of one) is an aliquot Part of a Pound, or of 2 s. *or when 'tis an aliquot Part of an aliquot Part of a Pound, or* 2 s. *in Mind.*

Case 1. *When the given Price is an aliquot Part of a Pound.*

Rule. Take a like Part of the given whole Number, esteemed as Pounds, as the given Price is of a Pound.

Ex. At 6 *s.* 8 *d. per* Yard, what will 439 Yards cost?

Here the given Price being $\frac{1}{3}$ of a Pound, I take $\frac{1}{3}$ of 439 *l.* (*viz.* 146 *l.* 6 *s.* 8 *d.*) for the Answer.

And had the given Price been 1 *s.* 1$\frac{1}{3}$ *d.* I would have found the Price as above, and then would have taken the 6th Part thereof, because this Price is one 6th of 6 *s.* 8 *d.* and in like manner for any other Case, when the Price is an aliquot Part, or an aliquot Part of an aliquot Part, *&c.*

Case 2. *When the given Price is an aliquot Part or Multiple of* 2 s.

Rule. Double the right-hand Figure of the given whole Number for Shillings, and esteem the rest of the given Number as Pounds, this is the Price at 2 *s.* then for the Amount at any other Price, take a like aliquot Part or Multiple of the Price at 2 *s.* as the given Price is of 2 *s.*

Ex. At 8 *d.* *per* ℔. what will 39 ℔. coſt?

3 *l.* 18 *s.* is the Price at 2 *s.* therefore ſince 8 *d.* is $\frac{1}{3}$ of 2 *s.* take $\frac{1}{3}$ of the Price at 2 *s.* *viz.* 1 *l.* 6 *s.*

Had the given Price been 1 Penny, I would have firſt found it at 8 *d.* as above, and then would have taken one-eighth thereof, &c.

Note, *If the given Number, whoſe Price was requir'd, had been a mix'd Number, this would have cauſ'd no Difficulty, nor no more Lines in the Work on account of the fractional Part.*

Ex. to Caſe 1. What will 346 Ct. 3 q. 14 ℔. coſt, at 3 *s.* 4 *d.* *per* Ct?

Here the Weight and odd Weight is immediately turn'd into Money (in Mind) at 1 *l.* *per* Ct. by Art. 51.

	l.	*s.*	*d.*
6)	346	17	6
Anſwer	57	16	3

And becauſe the given Price is $\frac{1}{6}$ of a Pound, I take $\frac{1}{6}$ of the Price at 1 *l.* and in like manner for any other Caſe, where odd Weight or Meaſure is given.

Ex. to Caſe 2. What will 346 Ct. 3 q. 14 ℔. come to, at 8 *s.* 3 *d.* *per* Ct?

Here the given Weight is immediately turned into Money, at 2 *s.* *per* Ct. by Art. 46, 47.

	l.	*s.*	*d.*	
8)	34	13	9	Price at 2 *s.*
			× 4	= $\frac{1}{2}$ of 8 *s.*
	138	15	.	
	+ 4	6	$8\frac{5}{8}$	
Anſw.	143	1	$8\frac{5}{8}$	

And then multiplying this Price by 4 gives the Price at 8 *s.* to which adding the 8th Part of the Price at 2 *s.* (becauſe 3 *d.* is the 8th Part of 2 *s.*) the Sum is the Price ſought.

And thus may the Price of any given Quantity, at the following Rates, or their aliquot Parts, or Multiples, be found, in Mind.

Rates.

	s.	d.	s.	s.	d.	s.	d.	s.	d.
Rates.	6	8 —	5 —	3	4 —	2	6 —	1	8

	d.	d.	d.	d.	d.	d.	d.	
or —	8 —	6 —	4 —	3 —	2 —	$1\frac{1}{2}$ —	1,	&c.

The first Rates being aliquot Parts of a Pound, and the second of 2 *s.*

66.

To bring Farthings to Pounds by two Divisions, in Mind.

Rule. Divide by 8, the Quote is Two-pences, and the Remainder Farthings; then cut off the right-hand Figure of the Two-pences, and divide the rest by 12, prefixing the Remainder of the Division by 12 before the Figure cut off, for the complete Remainder of this Division, this complete Remainder is Two-pences, and the Quote Pounds.

Ex. In 4977 Farthings, how many Pounds?

8) 4977 + 1 Farthing.

12) 62|2 + 22 Two-pences.

Answer 5 *l.* 3 *s.* $8\frac{1}{4}$ *d.*

67.

Having a Person's weekly Expences given, to find his Quarterly, in Mind.

Rule. As many Shillings, and as many Pence as you expend Pence *per* Week, will be your quarterly Expences.

Note, *For a Farthing in the given Expence, add* $3\frac{1}{4}$ *d.*

 Ex.

Ex. $8\frac{3}{4}$ *d. per* Week, what is it *per* Quarter?

Anſwer, 8 Pence *per* Week is 8 *s.* 8 *d. per* Quarter, to which adding $9\frac{3}{4}$ *d.* for the 3 Farthings, the whole makes 9 *s.* $5\frac{3}{4}$ *d. per* Quarter.

Caſe 2. *Having the quarterly Expences given, to find the weekly.*

Rule. For as many Shillings and Pence (of each an equal Number) as you expend *per* Quarter, reckon ſo many Pence, and for each $3\frac{1}{4}$ Pence in the Remainder, reckon a Farthing.

Ex. If I ſpend 12 *s.* $2\frac{1}{4}$ *d. per* Quarter, what are my weekly Expences?

In the given Expence, the greateſt equal Number of Shillings and Pence is 11, therefore reckon 11 Pence; now 11 *s.* 11 *d.* taken from the given Expence leaves $3\frac{1}{4}$ *d.* for which I reckon a Farthing; ſo the weekly Expence is $11\frac{1}{4}$ *d.*

68.

Having the weekly Expences given, to find the Annual, in Mind.

Rule. To as many Shillings and Pence as there are Farthings expended *per* Week, add one Day's Expence.

Ex. How much *per Annum* is $10\frac{1}{2}$ Pence *per* Week?

The given Expence is 42 Farthings, for which I reckon 42 *s.* and 42 *d.* that is 45 *s.* 6 *d.* to which adding $1\frac{1}{2}$ *d.* (one Day's Expence) the whole is 45 *s.* $7\frac{1}{2}$ *d.* the annual Expence.

69.

Having the daily Expences given, to find the Annual, in Mind.

Rule. For 7 times as many Farthings as are expended *per* Day, reckon as many Shillings, and as many Pence; to which adding one Day's Expence, you'll have the annual Expence.

Ex. How much *per Annum* is Three-pence *per* Day?

Here 7 times the Number of Farthings expended *per* Day is 84, for which I reckon 84 *s.* and 84 *d.* that is 4 *l.* 11 *s.* to which adding one Day's Expence, the whole is 4 *l.* 11 *s.* 3 *d.* the Anſwer.

Rule 2. Account the Pence that are expended *per* Day as ſo many Pounds, allowing a Crown for a Farthing; then, to this Sum, and the half thereof, add five Days Expence, the Sum of theſe three is the annual Expence.

Ex. What are my annual Expences, if my daily are 2 *s.* $4\frac{1}{2}$ *d.*

The daily Expence is $28\frac{1}{2}$ Pence, which I account 28 *l.* 10 *s.* the half of which is 14 *l.* 5 *s.* and the Sum is 42 *l.* 15 *s.* to which adding 5 Days Expence (*viz.* 11 *s.* $10\frac{1}{2}$ *d.*) the whole is 43 *l.* 6 *s.* $10\frac{1}{2}$ *d.* the annual Expence.

Note, *When the daily Expence is large, this is the beſt Rule.*

Caſe 2. *Having the annual Expence given, to find the daily, in Mind.*

Rule. From the given Number of Pounds (rejecting the given Shillings, &c.) ſubtract the 7th Part thereof, excluſive of the Unit's Place, one third of the Remainder is the Anſwer in Two-pences (or one 6th is the Anſwer in Groats.)

Ex. How much *per* Day is 1000 *l. per Annum?*

Excluding the Unit's Place, there remains 100, the 7th Part of which (rejecting the Remainder) is 14; which taken from 1000 leaves 986, the third Part of which is $328\frac{2}{3}$ Two-pences, the Anſwer.

Now, Two-pences are eaſily reduc'd to Pounds, *&c.* at once, by Art. 66. *viz.* by cutting off the right-hand Figure, and dividing the reſt by 12, the Quote is Pounds, and the complete Remainder Two-pences, and the 6th Part of this Remainder is Shillings.

Ex. Reduce the foreſaid $328\frac{2}{3}$ Two-pences to Pounds, *&c.*

The 12th Part of 32 is 2 *l.* and 8 over, which with the 8 cut off makes 88 Two-pences, the 6th Part of which is 14 *s.* and 4 Two-pences over; to which adding the Value of the Fraction (*viz.* $\frac{2}{3}$ of two-pence) we have 2 *l.* 14 *s.* $9\frac{1}{3}$ *d.* the Anſwer.

$$\begin{array}{r|l} 12)\,32 & 8\frac{2}{3} \\ \hline \end{array}$$
$$2\,l.\ 14\,s.\ 9\tfrac{1}{3}\,d.$$

Ex. 2. How much *per* Day is 89 *l.* 4 *s.* 10 *d.* *per Annum?*

Note, *When the given Annuity is leſs than* 70 l. *to the Pounds annex ſuch a Fraction as the odd Money is of a Pound; eſteem the third Part of this Sum as Two-pences, which reduce to Shillings, and deduct a Farthing for every Shilling therein.*

$$\begin{array}{r} 7)\,89 \\ -\,1 \\ \hline 3)\,88 \\ \hline \end{array}$$

Anſw. $29\frac{1}{3}$ Two-pences.

And theſe Rules will very rarely err a Farthing in the Anſwer: But for the Anſwer exact, apply this Rule: Eſteem the given Pounds as Two-pences, and the Shillings, *&c.* in the ſame Proportion; and from this Sum ſubtract the 73d Part thereof, $\frac{1}{3}$ of the Remainder is the Anſwer in Two-pences exactly.

Short Methods of turning inferior Denominations into Decimals, and vice versa.

70.

To turn Shillings, Pence, and Farthings into a Decimal of a Pound.

Rule 1st. For an even Number of Shillings (under 20) put down half that Number in the first decimal Place, and for an odd Shilling put down 5 in the second Place.

Ex. 16 *s.* = ,8 *l.*, and 1 *s.* = ,05 *l.*, therefore 17 *s.* = ,85 *l.*

2d. For any Sum under 12 Pence, reduce the given Sum into Farthings, which put in the second and third decimal Places, and add thereto $\frac{1}{24}$th Part of said Number.

Ex. What Decimal of a Pound is $6\frac{3}{4}$ *d?* Here $6\frac{3}{4}$ *d.* = 27 Farthings.

l. Therefore 24),027 Quote = ,001125 ——— Answer ,028125 *l.*	Or thus, for the Division by 24. 4),027 6),$\cancel{0}\cancel{0}\cancel{6}\cancel{7}\cancel{5}$ + ,001125 Quote. ——— Answer ,028125

Therefore 17 *s.* $6\frac{3}{4}$ *d.* = ,878125 *l.*

Or thus, for the Pence and Farthings.

Rule 2. Put down the Farthings in the ſecond and third decimal Places, adding 1 if they exceed 23; then multiply this Sum if under 25, otherwiſe its Exceſs above 25, or Twenty-fives, by 4, adding 1 for every 24 in the Product, annex this Sum to the laſt; and proceed in like manner with theſe two Figures, and ſo on with every ſucceeding Pair, till the Decimal appears finite (ending with 5) or circulating (ending with 3 or 6) or till you have a ſufficient Number of decimal Places.

Note, *This Limitation of the Decimal muſt be obſerv'd in every Rule.*

Ex. $5\frac{3}{4}$ d. = ,02395833, &c. l. Explanation, *viz.*

$23\times4+3=95$ | $20\times4+3=83$ | $8\times4+1=33$ |

But as this is a uſeful Caſe in Buſineſs, I ſhall give another Rule, more conciſe and expeditious than either of theſe.

Rule 3. For any Sum under 12 Pence.

Put down the given Sum reduced to Farthings, with 1 added if they exceed 23, in the ſecond and third decimal Places; then expunge 25 out of this Sum if it exceeds 25, and place the Remainder (or given Sum in Farthings, if leſs than 24) directly above the two next Places of the Decimal, and in this Situation multiply ſaid Remainder (or given Sum) by $4\frac{1}{6}$, and add the Product; that is, multiply by 4, and continue dividing by 6 till your Decimal appears finite or infinite, or till you have a ſufficient Number of decimal Places.

6) 3 (0
×4
—
6) 30

Ex. $6\frac{3}{4}$ d. =,028125 *viz.* $3\times4=12$; and 6)30(5
0

$$
\begin{array}{l}
6\,)\,23\,(\,3 \\
\quad \times 4 \\
\hline
6\,)\,5000
\end{array}
$$

Ex. 2. $\overset{d.}{5\tfrac{3}{4}} = ,02395833$, &c.

Here, 23 divided by 6, the Quote is 3, and the Remainder 5, and $23 \times 4 + 3 = 95$; and 6) 5000 (= 833, &c. repeating.

Now, tho' I have here wrote down the full Work (for Perspicuity sake) it is evident that the whole Operation is easily perform'd in Mind, and therefore only the Result (as found) need be wrote down.

Ex. 3. $\overset{d.}{3\tfrac{1}{4}} = ,013541\acute{6}$.

71.

To value the Decimal of a Pound by Inspection, without erring the tenth Part of a Farthing.

Rule. Double the Figure next the Point for a Shilling, and for 5 in the second Place account 1 Shilling.

Ex. ,95 *l.* = 19 *s.* Here 2 times 9 is 18 *s.* and for the 5 in the second Place I add 1 *s.* the Sum makes 19 *s.* the Value sought.

2. *To value a Decimal whose first Place is* 0, *and second under* 5 *by Inspection, so as not to err the tenth Part of a Farthing.*

Rule. To 4 times the Figure in the second Place, add half the greatest even Number in the third Place; subtract the Sum from the Figures in the second, third, and fourth Places, and pointing off the right-hand Figure of the Remainder for the Decimal of a Farthing, account the rest as so many Farthings.

EXAM-

EXAMPLES.

	1.	2.
	,036 *l.*	,029 *l.*
	—15	— 12
By the Rule.	Val. 34,5 *f.*	Value 27,8 *f.*
By the common Rules.	Ex. 34,56	Exact 27,84

3.	4.	5.	6.
,0298 *l.*	,0259 *l.*	,010 *l.*	,007 *l.*
—12	—10	—4	— 3
Val. 28,6 *f.*	Val. 24,9 *f.*	Val. 9,6 *f.*	Val. 6,7 *f.*
Ex. 28,608	Ex. 24,864	Ex. 9,6	Ex. 6,72

Ex. 1. 4 times 3 is 12, to which adding 3 (the $\frac{1}{2}$ of 6) the Sum 15, I ſubtract from 360, the Remainder 34,5 I account 34 Farthings, and 5 Tenths of a Farthing.

Ex. 6. The half of the greateſt even Number in 7 (*viz.* 6) is 3, which ſubtracted from 70, the Remainder is 67, that is, 6,7 Farthings; and that theſe Operations are eaſily perform'd in Mind, Experience will convince.

Note, *Under each Value found by the above Rule, I have placed the exact Value found by the common Rules, to ſhew how nearly they agree.*

72.

To change Quarters, Pounds, &c. *into a Decimal of* 1 *Ct.*

Rule 1. For a Quarter put down ,25.

2. And for any Number of Pounds under 28, multiply the Decimal ,00892857 by the given Number of Pounds.

Note, *For any Number of Pounds under* 22, *you need write down only the Reſult.* (See Art. 12.)

Ex.

Ex. 1. What Decimal of 1 Ct. is 17 ℔?

,00892857
× .7

Anſwer ,15178569 Ct.

Ex. 2. What Decimal of 1 Ct. is $27\frac{1}{4}$ ℔?

,25
4) ,~~00892857~~
— ,00223214

Anſwer ,24776786 Ct.

Either of theſe requires a tedious and troubleſome Diviſion, by the common Rules.

Note, *This Rule generally gives the Decimal true to the ſixth Place.*

73.

To reduce the Decimal of a Hundred into Pounds, giving only the Anſwer.

Rule. Multiply the given Decimal by 112, by Art. 12. *viz.* multiply by 12, and add the right-hand Figure of the Multiplicand to the Product at the third Step, and then at every ſucceeding Step take in the next Figure to the left of the laſt taken in, till you have multiply'd the laſt Figure of the Multiplicand, and put down the Product-figure at that Step, after which add the Number to carry to the Sum of the two laſt Figures of the Multiplicand, and put down the Sum.

Ex. Reduce the Decimal ,15178569 Ct. to ℔s?
× .12

Anſwer 16,99999728 or 17 ℔. near.

Or

3

Or thus.

Rule 2. Divide the given Decimal by ,008928.

Ex. 2. ,008928) ,151785, &c. (17 ℔. Anſwer.
.62505
.9

But the firſt is the beſt Rule.

74.

To value the Decimal of a ℔. Avoirdupoiſe Weight, giving only the Anſwer.

Rule. Multiply by 16, by Art. 12, *viz.* to the Product by 6 add the right-hand Figure at every Step; and in like Manner you may find the Value of the Decimal of an Ounce, or a Dram.

℔.
Ex. Reduce ,764 to Ounces and Drams.
× .6

Ounces 12,224
× .6

Drams 3,584

75.

To value the Decimal of a Foot, by Inſpection.

Rule. For every Tenth under or over ,5 (for which allow 6 Inches) reckon as many Inches, and as many Quarters; and for every 3 in the ſecond Place, add a Quarter of an Inch.

I. q. q. I. q. I.
Ex. 1. ,37*f.* = 3 3 + 2 = 4 1. | Ex. 2. ,87*f.* = 10¼.

76,

76.

To value the Decimal of a Gallon, writing down only the Answer.

Rule. Multiply the Figure next the decimal Point by 8, and eſteem the left-hand Figure of the Product as Pints; then add the right-hand Figure of the Product to the ſecond Figure of the given Decimal, which Sum multiply by 4, and eſteem the left-hand Figure of the Product as Quarterns.

	G.		G.	
Ex. Given	,97	and	,78	to reduce to P. and Q.
Pints	7|2			
	9			
	×4			
Quarterns	3|6			

In the 2d Ex. 8 times 7 is 56, the 5 I call 5 Pints; then 6 and 8 is 14, and 4 times 14 is 56, the 6 I reject, and the 5 I call 5 Quarterns, which added to 5 Pints, makes $6\frac{1}{4}$ Pints.

77.

To turn the Decimal of a Barrel into Gallons.

Rule. Remove the decimal Point one Place towards the right-hand, in the given Decimal; and then having multiplied by 4, from the Product ſubtract the tenth Part thereof (for the tenth Part remove the decimal Point one Place towards the left-hand).

Ex.

	B.	Or thus.
	Ex. Reduce ,467 into Gallons.	4,67
* Or thus.	18,68	—18,68
—467	—1,868	Anſw. 16,812
4,203	———	G. p. q.
Anſ. 16,812	Anſ. 16,812 G. = 16 6 2 by Art. 72.	

* Hence, theſe Kind of Operations are eaſily perform'd in Mind.

SIM-

SIMPLE INTEREST.

78.

To find the Interest of any given Sum at 10 per Cent. *giving only the Answer.*

Rule. To double the right-hand Figure of the given Pounds, add the left-hand Figure of the given Shillings, and esteem the Sum as so many Shillings, and the rest of the given Pounds esteem as so many Pounds; then to 12 times the right-hand Figure of the given Shillings add the given Pence, and excluding the right-hand Figure of this Sum, put down the rest as Pence, and call every Farthing in the Remainder the 40th Part of a Penny.

Ex. 1. What is the Interest of 436 *l.* 16 *s.* 8 *d.* for 1 Year, at 10 *per Cent. per Annum?* Answer 43 *l.* 13 *s.* 8 *d.*

Here, the 43 I esteem as 43 *l.* and to twice 6 (*viz.* the given *l.* 6) I add the 1 in the given Shillings, the Sum (13) I put down in the Place of Shillings; then to 12 times 6 (in the given Shillings) I add the 8 in the given Pence, and from the Sum (80) I exclude the 0, and put down the 8 in the Place of Pence.

Ex. 2. Requir'd the Interest of 97 *l.* 04 *s.* 11$\frac{1}{2}$ *d.* at 10 *per Cent?* Answer 9 14 5$\frac{38}{40}$.

Note, *The excluded Figure in the Pence being* 9, *the Remainder is* 9$\frac{1}{2}$ d. (*adding the given* $\frac{1}{2}$ d.) *which reduc'd to Farthings make* 38, *which I esteem as* $\frac{38}{40}$ *of a Penny.*

79.

79.

To find the Intereſt of any given Sum at any Rate, by firſt finding the Intereſt at 10 per Cent.

Rule. Having found the Intereſt at 10 *per Cent.* (by Art. 78.) take ſuch Parts (or Multiple) of the Intereſt at 10 *per Cent.* as the given Rate (or Product of the Rate and Time) is of 10.

Examples. Requir'd the Intereſt of 436 *l.* 16 *s.* 8 *d.* at theſe ſeveral Rates, *viz.* 5 *per Cent.* $2\frac{1}{2}$ *per Cent.* at $1\frac{1}{4}$, and at $7\frac{1}{2}$ *per Cent.* for 1 Year.

	l.	*s.*	*d.*	
Ex. 1.	43	13	8	Int. at 10 *per Cent.* by Art. 78.
2)				
Anſwer	21	16	10	at 5 *per Cent.*

Ex. 2.	43	13	8	at 10
$2\frac{1}{2} = \frac{1}{4} =$	10	18	5	at $2\frac{1}{2}$
Ex. 3.	43	13	8	at 10
$1\frac{1}{4} = \frac{1}{8} =$	5	9	$2\frac{1}{2}$	at $1\frac{1}{4}$
Ex. 4.	43	13	8	at 10
$5 = \frac{1}{2} =$	21	16	10	
$2\frac{1}{2} = \frac{1}{2} =$	10	18	5	
	32	15	3	at $7\frac{1}{2}$

Or thus.

4)	43	13	8	
—	10	18	5	
	32	15	3	at $7\frac{1}{2}$

Some

Some Examples wherein Times are concern'd.

Ex. 5. Requir'd the Intereſt of 768 *l.* 19 *s.* $6\frac{1}{2}$ *d.* for 3 Years and 4 Months, at 3 *per Cent. per Ann.*

Anſwer 76 *l.* 17 *s.* $11\frac{18}{40}$ *d.* at $10 = 3\frac{1}{3} \times 3$.

	l.	*s.*	*d.*	
Ex. 6.	768	19	$6\frac{1}{2}$	at 4 *per Cent. per Ann.* for 3 Years,
	76	17	$11\frac{18}{40}$	at 10
$2 = \frac{1}{5} =$	15	7	$7\frac{3\frac{3}{5}}{40}$	at 2
Anſwer	92	5	$6\frac{21\frac{3}{5}}{40}$	at $12 = 4 \times 3$

(Note $\frac{21\frac{3}{5}}{40} = \frac{27}{50}$ *d.*)

Ex. 7. 5948 *l.* 01 *s.* $3\frac{1}{4}$ *d.* at 8 *per Cent.* for 2 Years and $9\frac{3}{4}$ Months?

	594	16	$1\frac{21}{40}$	at 10
4)	594	16	$1\frac{21}{40}$	at 10
	148	14	$0\frac{15\frac{1}{4}}{40}$	at $2\frac{1}{2}$
Anſwer	1338	6	$3\frac{17\frac{1}{4}}{40}$	at $22\frac{1}{2} = 2\frac{6\frac{1}{2}}{8} \times 8$

Or thus.

4)	594	16	$1\frac{21}{40}$
			$\times 2$
	1189	12	$3\frac{1}{20}$
	148	14	$0\frac{61}{160}$
Anſwer	1338	6	$3\frac{69}{160}$

 And

And in like manner may the Intereſt of any Sum be found at any Rate and Time, by firſt finding the Intereſt at 10 *per Cent.* and then applying Art. 79.

80.

To find the Intereſt of any Sum at any Rate, &c. *another way.*

Rule. Multiply the given Principal by the Product of the given Rate and Time, and cut off the two right-hand Figures in every Denomination; the left-hand Figures remaining are the Intereſt ſought.

	l.	s.	d.	
Ex. 1. Requir'd the Int. of	768	19	$6\frac{1}{2}$	for 4 Years, at 3 *per Cent.*
			$\times$ 12	
Anſwer	l. 92|27	14	6	
	s. 5|54			
	d. 6|54			
	100			

Ex. 2. What will the Intereſt of an Annuity of 374 *l.* 12 *s.* 9 *d.* to continue 50 Years, at $4\frac{1}{2}$ *per Cent. per Ann.* amount to, at ſimple Intereſt, paid yearly?

	l.	s.	d.		
	374	12	9		
	1873	3	9	Prod. by 5.	50
	7492	15	0	Prod. by 4.	$\times 4\frac{1}{2}$
	74927	10	0	Prod. by 10.	200
					25
Anſwer	842|93	8	9		225
	s. 18|68				
	d. 8|$\frac{25}{100}$ | $\frac{1}{4}$				

Ex.

Ex. 3. Suppose the above Annuity were to continue 46 Years, at 5 *per Cent.*

	l.	s.	d.
	374	12	9
	11239	2	6
	74927	10	0
Answer *l.*	861|66	12	6
s.	13|32		
d.	3|$\frac{90}{100}$ | $\frac{9}{10}$		

46
×5
230 Mult.

30 *d.*
18|2 *s.*

600
55|0

81.

When the Rate or Time is an aliquot Part of 100, *take a like Part of the Principal, and multiply it by the Time or Rate, for the Interest sought.*

Or when the Product of the Rate and Time is an aliquot Part of 100, *take a like Part of the given Principal, for the Interest sought.*

Or when these are Multiples of 100, *take like Multiples of the given Principal.*

Hence all Cases of simple Interest (where the Interest or Amount is sought) may be wrought by this Method.

Ex. 1. What's the Interest of 768 *l.* 19 *s.* 6½ *d.* for 33⅓ Years, at 4 *per Cent?*

	l.	s.	d.
3)	768	19	6½
	256	6	6⅙
			×4
Ans.	1025	6	0⅔

33⅓ = ⅓ of 100

Or thus.

		l.	s.	d.
	3)	768	19	$6\frac{1}{2}$
	+	256	6	$6\frac{1}{6}$
Anſwer		1025	6	$0\frac{2}{3}$

			l.	s.	d.
Ex. 2. of Art. 79. - - -			374	12	9
100) 225		4)	374	12	9
$2\frac{1}{4}$			93	13	$2\frac{1}{4}$
	Anſwer		842	18	$8\frac{1}{4}$ as before.

		l.	s.	d.
Ex. 3. of Art. 79. - -		374	12	9
		374	12	9
100) 230	$20 = \frac{1}{5} =$	74	18	$6\frac{3}{5}$
$2\frac{3}{10}$	$10 = \frac{1}{2} =$	37	9	$3\frac{3}{10}$
	Anſwer	861	13	$3\frac{9}{10}$ as before.

82.

To find the Intereſt for any given Number of Days.

Rule. Multiply the Principal by the Product of the Rate and Number of Days; this Product divided by 36500, quotes the Anſwer, in the Denomination of the Principal, after the Multiplication. Conſequently, if the Principal be reduced to Shillings, the Anſwer will be given in Shillings; and if the Principal be reduced to Pence, the Anſwer will be given in Pence, &c.

Note, *When the Diviſor and any one of the Factors* (viz. *Rate or Time*) *can be divided by a common Meaſure, you may uſe the Quotients inſtead of the correſponding given Terms.*

Ex.

l. *s.* *d.*

Ex. Requir'd the Int. of 437 19 4 for 174 Days, at 5 *per Cent. per Ann.*

$\times 5$

30657 13 4 — 870 Prod.

350373 6 8 — 40

$15|3$

l. *s.* *d.*

$365|0\cancel{0}$) $3810|31$ (10 8 $9\frac{747}{1825}$ — 800

$146|6$

. 16031

) $3206|2\cancel{0}$

2862

) $3434|4$

1494

$\frac{5}{36500}$ | $\frac{1}{7300}$. Hence we might have multiplied by 174, and divided by 7300; but this would have been no Contraction of the above.

l. *s.*

Ex. 2. Requir'd the Int. of 436 10 for 45 Days, at 6 *per Cent.*

8730 *s.*

$\times 6$

52380

$\times 9$

s. *d.* *q.*

$\frac{45}{365000}$ | $\frac{9}{7300}$ $73|0\cancel{0}$) $4714|2\cancel{0}$ (64 6 $3\frac{273}{365}$ Anf,

334

422

) $506|4$ *d.*

684

) $273|6$ *f*

546

Ex. 3. What is the Intereſt of 436 *l.* 16 *s.* 8 *d.* for 45 Days, at $8\frac{1}{9}$ *per Cent.*

9) 45	*l.* 4 | 36 16 8
× 8	
360	*s.* 7 | 36
+ 5	*d.* 4 | $\frac{40}{100}$ | $\frac{2}{5}$
365	

Anſwer 4 *l.* 7 *s.* $4\frac{2}{5}$ *d.*

83.

DISCOMPT.

The common Rules for Difcompt I have given in the firft Volume; the following is not fo common.

Rule. Firft find the Intereft of the given Sum (to be difcompted) for the given Time; and then find the prefent Worth of that Intereft; this prefent Worth is the Difcompt of the given Sum; that is, the prefent Worth of the Intereft of the Debt, is the Difcompt of faid Debt.

Ex. How much prefent Money fhould I receive for a Debt of 4925 *l.* 5 *s.* due 2 Years and 8 Months hence, allowing Difcompt at the Rate of 3 *per Cent. per Annum?*

l. *s.*
£. 4925 5
S. 98505
D. 11820|60 or $\frac{3}{5}$
×8
108 — 100 — 94564$\frac{4}{5}$ Intereft.
S. 2160 · 5 Mult: by 5 on acc. of ⅘ fr
D. 25920 x 5

			l.	*s.*	*d.*	
p. ad. 1290|00 — —	) 472824		—364	16	8	Difcount.
	8402		4925	5	0	Debt.
	6264					
	1080		4560	8	4	Anf. prefent Worth.
	) 21600					
	8640					
108	) 864					

...

Note,

Note, *This is a Matter of Curiosity only; but the following are Abbreviations in Discompt.*

84.

Abbreviations in Discompt.

	Rates.	
at	$1\frac{1}{4}$	$\div$ 81 (or by 9 and by 9)
	2	$\div$ 51
	$2\frac{1}{2}$	$\div$ 41
	4	$\div$ 26
	5	$\div$ 21 (or by 7 and by 3)
	6	$\div$ 53 and $\times$ 3
	$7\frac{1}{2}$	$\div$ 43 and $\times$ 3
	8	$\div$ 27 and $\times$ 2 (or $\times$ 2, and $\div$ 9 and by 3)
	$8\frac{1}{3}$	$\div$ 13
	10	$\div$ 11
	12	$\div$ 28 and $\times$ 3 (or $\times$ 3, and $\div$ 7 and by 4)
	$12\frac{1}{2}$	$\div$ 9

Note, *Any Principal to be discompted for one Year at any of the above Rates (or for any Rate and Time, whose Product is equal to any of the above Rates) being (multiplied by the Multiplier, if any, and) divided by the corresponding Divisor, the Quote is the Discompt.*

Ex. How much must I abate of 4925 *l.* 5 *s.* due 3 Years hence, discompting at $2\frac{2}{3}$ *per Cent. per Ann.*

		l.	*s.*	
$2\frac{2}{3}$		4925	5	
$\times 3$		4925	5	
8 therefore $\times$ 2 and $\div$ 27	9)	9850	10	
	3)	1094	10	
	Answer	364	16	8

Ex.

Ex. 2. What is the Discompt of 447 *l.* 15 *s.* 1 *d.* for $2\frac{1}{2}$ Years, at 1 *per Cent*?

	l.	*s*	*d.*	*l.*	*s.*	*d.*	
41)	447	15	1 (	10	18	5	Answer,
	37						
	)755						
	345						
	17						
	)205						
	..						

85.

SIMPLE INTEREST DECIMALLY.

Case 1. *Given the Principal, Rate and Time, to find the Interest or Amount.*

Rule. Reduce the odd Shillings, Pence and Farthings to a Decimal of a Pound Sterling, by Art. 70. and then multiply the Principal by the Product of the Rate and Time in a decimal Form, this Product is the Interest sought.

Note, *If the given Rate be* 6 per Cent. *this in a decimal Form is* ,06; *and* 8 per Cent. *is* ,08, *and so on. If the given Rate be* $\frac{1}{4}$ per Cent. *the Decimal is* ,0025, &c.

Ex. 1. Requir'd the Interest of 897 *l.* 18 *s.* 6 *d.* for 1 Year, at 7 *per Cent.*

$$\begin{array}{r} 897,925 \\ \times\, ,07 \\ \hline \end{array}$$

Answer 62,85475 *l.*

Ex. 2. - - - - - - 897,925 at $\frac{3}{4}$ *per Cent.*

$$\begin{array}{r} 897,925 \\ \times\, ,0075 \\ \hline 4489625 \\ 6285475 \\ \hline \end{array}$$

Answer 6,7344375 *l.*

Ex.

Ex. 3. Requir'd the Int. of 569 *l.* 14 *s.* 9 *d.* for 4 Years, at $3\frac{1}{2}$ *per Cent.*

$$569,7375$$
$$\times\,.\,14 = ,035 \times 4$$

Answer 79,763250 *l.*

Case 2, *Given the Amount, Time and Interest, to find the Rate.*

Rule. Divide the Interest by the Product of the Principal and Time, the Quote is the Rate.

Ex. If in 4 Years 372 *l.* 15 *s.* 10 *d.* amount to 484 *l.* 12 *s.* 7 *d.* what Rate *per Cent. per Annum* was then paid for the Principal?

	l.	*s.*	*d.*
Amount	484	12	7
Principal	372	15	10
Interest	111	16	9

372,7916 Decimal
×4

1491,1664) 111,8375000 (,075 = $7\frac{1}{2}$ *per Cent.* the Rate sought.
74558520
200 rejected.

Case 3. *Given the Amount, Rate and Interest, to find the Time.*

Rule. Divide the Interest by the Product of the Principal and Rate (in a decimal Form) the Quote is the Time.

Ex. 3

Ex. In what Time will 372 *l.* 15 *s.* 10 *d.* gain 111 *l.* 16 *s.* 9 *d.* at $7\frac{1}{2}$ *per Cent. per Annum?*

372,7916 Principal.
× ,075 Rate.

18639580
26095412

27,95937|00 (111,83750 (4 Years, Anſwer.
..2

Caſe 4. *Given the Amount, Rate and Time, to find the Principal?*

Rule. To the Product of the Time and Rate add 1, then divide the given Amount by this Sum, the Quote is the Principal ſought.

Ex. Having lent a certain Sum for 4 Years, at $5\frac{1}{2}$ *per Cent. per Annum*, I demand what that Sum was, if I receive 2053 *l.* 13 *s.* 4 *d.* for Principal and Intereſt?

,055
× 4 *l.* *l.* *s.* *d.*

1,220) 2053,666 (1683,333, &c. = 1683 6 8 Anſ.
833
1016
406
406
.40

86.

COMPOUND INTEREST DECIMALLY.

Caſe 1. *Given the Principal, Rate and Time, to find the Amount.*

Rule. Raiſe the Amount of 1 *l.* for 1 Year (which is here call'd the Rate) to a Power, whoſe Index is the Time, this Power multiply by the given Prinpal, the Product is the Amount ſought.

Ex. What will 372 *l.* amount to in 3 Years, at 4 *per Cent. per Annum*, compound Intereſt?

```
      1,04  Amount of 1 l. for 1 Year,
    × 1,04                call'd the Rate.
    ------
    1,0816  the ſecond Power.
    × 1,04
  --------
  1,124864  the third Power.
     × 372  the given Principal.
  --------
   2249728
  7874048
 3374592
 ---------
Anſwer 418,449408 l.
```

Caſe 2. *Given the Amount, Rate and Time, to find the Principal.*

Rule. Divide the Amount by that Power of the Rate whoſe Index is the Time, the Quote is the Principal.

Ex.

3

Ex. What Principal will amount to 551 *l.* 5 *s.* in 2 Years, at 5 *per Cent. per Annum?*

	Rate 1,05		
	× 1,05		
		Amount.	*l.*
Index 2.	1,1025)	551,2500 (	500 Anſwer.

Caſe 3. *Given the Amount, Principal and Rate, to find the Time.*

Rule. Raiſe the Rate to a Power equal to the Quotient of the Amount, divided by the Principal, the Index of this Power of the Rate, is the Time ſought.

Example. In what Time will 372 *l.* amount to *l.* 418,449408 (or 418 *l.* 8 *s.* 11$\frac{3}{4}$ *d.* nearly) at 4 *per Cent. per Annum?*

Princip. 372 (418,449408 (1,124864 Quote *.	
464	
924	1,04
1809	× 1,04
3214	
2380	1,0816
1488	× 1,04
..	
	1,124864 Power

equal to the above Quote *, and the Index of this Power is 3, therefore 3 Years is the Time ſought.

Caſe 4. *Given the Amount, Principal and Time, to find the Rate.*

Rule. Divide the Amount by the Principal, and extract that Root of the Quote, whoſe Exponent is the Time; this Root is the Rate ſought.

Ex.

Ex. At what Rate *per Cent. per Annum* will 372 *l.* amount to *l.* 418,449408 in 3 Years?

Quote
Cube Root.

372) 418,449408 (1,124864 (1,04 Rate.
30000) 124864 Exponent 3.

120000
4800
64

— 124864
0

Answer, the Rate sought is 4 *per Cent. per Ann.*

Note, *If the given Time exceeds 3 Years, you must apply the general Rules for Extraction of Roots, hereafter given.*

AL-

ALLIGATION.

87.

In Alligation Medial, you may reduce the given Quantities (or firſt and third Terms) in any common Ratio, and then uſe theſe reduced Terms inſtead of the given Terms.

Ex. Bought 36 Buſhels of Barley at 4 *s.* and 12 Buſhels of Wheat at 8 *s.* and 6 Buſhels of Rye at 2 *s.* 8 *d.* and having mixed all theſe together, I deſire to know the prime Coſt of a Buſhel of the Compound.

$$
\begin{array}{ccccccc}
 & \text{Buſh}^{s}. & \text{Red.} & & s. & & s. \\
\div 6 & \left\{\begin{array}{r} 36 \\ 12 \\ 6 \end{array}\right. & \left\{\begin{array}{c} 6 \\ 2 \\ 1 \end{array}\right. & \begin{array}{c} \times \\ \times \\ \times \end{array} & \begin{array}{l} 4 \\ 8 \\ 2\ 8\,d. \end{array} & \begin{array}{c} = \\ = \\ = \end{array} & \begin{array}{l} 24 \\ 16 \\ 2\ 8\,d. \end{array} \\
\hline
 & & 9 & &) & & 42\ 8 \\
\hline
 & & & & \text{Anſwer} & & 4\ 8\tfrac{8}{9}
\end{array}
$$

88.

When the given Quantities are equal in Quantity (or Number) but ſold at different Rates.

Rule. Divide the Sum of the particular Rates by the Number of Sorts (or Kinds) in the given Quantities, the Quotient is the mean Price of the Mixture.

Ex.

Ex. Bought 4 different ſorts of Spices, of each an equal Quantity; the firſt Sort at 20 *s.* 6 *d.* the ſecond at 16 *s.* 3 *d.* the third at 12 *s.* and the fourth at 9 *s.* 4½ *per* ℔. I demand the mean Price of 1 ℔. of the Mixture?

THE WORK.

	s.	*d.*	
	20	6	
	16	3	
	12	0	
	9	4½	
4)	58	1½	Sum.
Anſwer	14	6⅜	the Value of 1 ℔.

89.

When the Prices are in arithmetical Progreſſion, and the Quantities equal,

Rule. Take half the Sum of the leaſt and greateſt given Rates, for the mean Rate ſought.

Ex. Bought 5 different Sorts of Wines (of each an equal Quantity) at the following Rates;

viz. 4 *s.* 6 *s.* 8 *s.* 10 *s.* 12 *s.* *per* Gallon;

what do theſe Wines ſtand me *per* Gallon, one with another?

Note, *When the Number of Sorts is odd; then, that given Rate which exceeds the leaſt, as much as the greateſt exceeds it, is the mean Rate.*

	4	leaſt.
	12	greateſt.
2)	16	Sum
Anſwer	8 *s.*	

So in this Example, 8 exceeds 4, as much as 12 exceeds 8; therefore we might have taken 8 as the mean Rate sought, without any preparatory Work.

Ex. 2. Having melted together the following Quantities of Gold, *viz.* $3\frac{1}{2}$ Ounces of $15\frac{1}{4}$ Carats fine; ditto of $17\frac{1}{2}$ fine; of $19\frac{3}{4}$ fine; of 22 fine; of 13; and of $10\frac{3}{4}$ Carats fine, I desire to know the Fineness of the Mixture?

least $10\frac{3}{4}$ fine.
greatest 22 fine.

2) $32\frac{3}{4}$

Answer $16\frac{3}{8}$ fine.

90.

Some curious Methods of solving Alligation, by which a great Variety of Answers may be obtain'd, which cannot be found by the common Rules.

Having the particular Rates given, and the mean Rate assign'd, to find the particular Quantities.

After you have found the respective Quantities by the common Rules of Alligation, other Quantities may be found by this

Rule. Link together any two of the Quantities (which you intend to change) found by the common Rules; then to the Right of these Quantities, place the Differences of their Prices, and the mean Price alternately; and increase or diminish the Quantities (found by the common Rules) by their opposite Differences respectively; that is, if the corresponding Prices are both greater or both less than the mean Price, you must increase one Quantity (*viz.* either) by its opposite Difference, and (contrarily) decrease the other Quantity by its opposite Difference.

But if one of these (two) Prices be greater, and the other less than the mean Price, then the corresponding Quantities must be both increased or both dimi-

diminiſhed by their reſpective oppoſite Differences: And the increaſed or diminiſhed Quantities thus found will be new Anſwers to the Queſtion, which could not be found by the common Rules.

Ex. A Vintner intending to mix Wines of 16, 14, and 2 Shillings *per* Gallon, deſires to know how much he muſt take of each Sort, to make a Mixture worth 12 *s.* *per* Gallon?

$$12\left\{\begin{array}{ll} a & 16 \\ b & 14 \\ c & 2 \end{array}\right. \qquad \begin{array}{r} \text{Gal.} \\ =10 \\ =10 \\ 4+2=\ 6 \end{array}\left.\vphantom{\begin{array}{l}a\\b\\c\\d\end{array}}\right\}\text{Anſw. by the common Rule.}$$

Now, tho' we can find but this one Anſwer by the common Rule of Alligation (there being no other way of linking applicable in this Caſe) and other Quantities in the ſame Proportion by the Rule of Three; yet by the foregoing Rule, we may find innumerable other Quantities (which are not in the ſame Proportion as theſe) that will equally anſwer the Conditions of the Queſtion.

Thus.

$$\begin{array}{ccccc} & s. & \text{G.} & \begin{array}{c}\text{Anſ.}\\ \text{G.}\end{array} & & \begin{array}{c}\text{Anſ.}\\ \text{G.}\end{array} \\ 12\left\{\begin{array}{l}\\ \\ \end{array}\right. & \begin{array}{c}16\\14\end{array} & \begin{array}{c}10\\10\end{array} & \begin{array}{r}-2=\ 8\\+4=14\end{array}\left\{\begin{array}{l}\\ \\ \end{array}\right. \text{or} & \begin{array}{r}10+2=12\\10-4=\ 6\end{array} & \text{\&c.} \end{array}$$

Hence, making the Quantity of 2 *s.* Wine invariable, we may find 6 Anſwers (beſides that found by the common Rules) for the Quantity of the 16 *s.* Wine may be increaſed or diminiſhed by 2 as oft as poſſible, if at the ſame time we (contrarily) diminiſh or increaſe the Quantity of of 14 *s.* Wine by 4.

Note, *The Reaſon of decreaſing the one, while we increaſe the other, is becauſe both their Rates* (14 *and* 16) *are greater than the mean Rate* 12; *and the ſame would hold if they had been both leſs than the mean Rate, as obſerved in the Rule.*

VARIETIES.

	14	12	*a* 10	8	6	4	2	
limited	2	6	*b* 10	14	18	22	26	limited.
	6	6	*c* 6	6	6	6	6	

Here we have 6 Anſwers beſides that found by the common Rule of Alligation; and if we increaſe theſe Quantities in any common Proportion, the Queſtion will admit an infinite Number of other Anſwers.

2. Making the Quantity of 14 *s.* Wine invariable, we may vary the Quantities of the 16 and 2 Shilling Wines, which will admit an infinite Number of Anſwers.

Ex.

$$12\left\{\begin{array}{lll} 16 & a\ 10 & +10=20 \text{ Gallons at } 16s. \\ 2 & c\ \ 6 & +\ 4=10 \text{ Gallons at } 2s. \end{array}\right. \quad \text{\&c.}$$

(Anſ. = 20 Gallons at 16 *s.*, 10 Gallons at 2 *s.*)

Hence we may increaſe both theſe Quantities (20 and 10) without end, by continually adding 10 Gallons to the 16 *s.* Wine, and 4 Gallons to the 2 *s.* Wine.

Note, *The Reaſon we continually increaſe both Quantities here, is becauſe one of the Rates* (16 *and* 2) *is greater, and the other leſs than the mean Rate* 12. *But we cannot find one Anſwer by Subtraction (in this Caſe) becauſe* 10 *taken from* 10 *leaves* 0.

3d. Making the 16 *s.* Wine invariable, we may find other Anſwers, by varying the Quantities of the 14 *s.* and 2 *s.* Wines.

Ex.

$$12\left\{\begin{array}{lll} 14 & b\ 10 & +\ 10 = 20 \\ 2 & c\ \ 6 & +\ \ 2 = \ 8 \end{array}\right. \quad \text{\&c.}$$

Hence, we may continually increaſe the Quantity of the 14 *s.* Wine by 10 Gallons, if we alſo continually increaſe the Quantity of the 2 *s.* Wine by 2 Gallons.

But

But though we can find an infinite Number of Answers in this Case, by a continual Addition, yet we cannot find one Answer by Subtraction.

Again,

'Tis required to vary all the Quantities in the foregoing Question.

	Com.		Anf.
	R.		G.
12 { 16	10	+ 10 — 2	= 18
14	10	+ 4	= 14
2	6	+ 4	= 10

And by this Solution we continually vary all the Quantities, by adding (as oft as we pleafe) 8 Gallons to the 16*s.* Wine, 4 to the 14*s.* Wine, and 4 to the 2*s.* Wine. The fame Method may be applied to any Number of Things to be alligated.

Ex. 2. A Vintner mixing Wines of 8 and 7 Shillings *per* Gallon, with Gin at 4*s.* *per* Gallon, and Cyder at 1*s.* *per* Gallon, defires to know what Quantities he fhould take of each Sort, to make the Compound worth a Crown a Gallon?

Thus.

	Com.		Anf.		
	R.		G.	*s.*	*s.*
5 { 8	4	— 2	= 2	at 8	= 16
7	1	+ 3	= 4	at 7	= 28
1	3	— 1	= 2	at 1	= 2
4	2	+ 4	= 6	at 4	= 24
		Proof	14	)	70 (5*s.* *per* Gallon.

Here alfo, all the Quantities are varied at once.

91.

ALLIGATION TOTAL;

Thus denominated, from the total Quantity's being assign'd.

Having found the proper respective Quantities by the common Rules, other Answers may be found by this

Rule. 1. Take that Simple, whose Value alone is greater or less than the mean Rate, and increase or diminish the Quantity of this Simple, by the Difference of the Differences between the Rates of the other two Simples, and the mean Rate.

2. Of the remaining two Simples, let the Quantity of that Simple, whose Value is farthest from the mean Rate, be increased or decreased (as the former is) by the Sum of the Differences between the Rates of the other two Simples, and the mean Rate.

3. Let the Quantity of the remaining Simple be decreased or increased by the Sum of the Differences between the Rates of the other two Simples, and the mean Rate; that is, this Simple is to be increased when the other two Simples are decreased, and contrarily.

Ex. 'Tis requir'd to mix Wines of 16, 14, and 2 Shillings *per* Gallon, so that the Compound shall contain exactly 78 Gallons, and be worth 12 *s. per* Gallon?

$$\begin{array}{lll} & \text{G.} & \text{Ans. by R. 91.} \\ 12\left\{\begin{array}{l}16\\14\\2\end{array}\right. & \begin{array}{l}10\times3=30\\10\times3=30\\6\times3=18\end{array} & \begin{array}{l}+\overline{10+2}=42\\-\overline{10+4}=16\\+\ \overline{4-2}=20\end{array} \\ \text{Ans. by com. R.} & \overline{78} & \qquad\quad \overline{78} \end{array}$$

3

Or

Or thus.

$$12\begin{cases}16 - - 30 - 12 = 18 \\ 14 - - 30 + 14 = 44 \\ 2 - - 18 - 2 = 16\end{cases}$$

Anf. — Sum 78 Gallons.

Hence we have two Anfwers, befides that found by the common Rule (which is 30, 30, and 18 G.) the firft is 42 Gall. at 16*s.* 16 Gall. at 14*s.* and 20 at 2*s.*

The fecond Anfwer is 18 at 16*s.* 44 at 14*s.* and 16 at 2*s.*

92.

* But there is yet a much better Method for varying the Quantities in this Cafe (*viz.* Alligation total) in *Fletcher's* Tranflation of an anonymous *French* Author's Arithmetic, *viz.*

Rule. Take any Quantities of each given kind, whofe Total fhall be equal to the Total affign'd for the Compound, and find the total Value of thefe affum'd Quantities at their refpective given Rates; and having found the Difference between this total Value (or Amount) and the true Amount: Then, if the falfe Amount exceeds the true (it is evident, that you have taken too many at a high Rate, and too few at a low Rate, and confequently) you muft expunge a proper Number at a high Rate, and add a like Number at a low Rate; and contrarily when the falfe Amount is too little. And

To find the proper Number to be added at one Rate, and fubtracted at another Rate, take this

Rule. Having found the Difference between the falfe Amount and the true Amount, divide this Difference

by the Difference of any two given Rates; and if nothing remains, the Quotient is the Number to be added at the low Rate, and ſubtracted at the high Rate, when the falſe Amount is too great, and the contrary when 'tis too little. But if there is a Remainder, that Remainder muſt be divided by another Difference of two given Rates (and ſo on till nothing remains) and the Quotient muſt be added to one of theſe Simples, and ſubtracted from the other, according as the falſe Amount is too great or too little, as above directed.

Ex. Solution of the laſt Example, by this Rule.

	Gal.		s.		s.
Aſſum'd Quantities	34	at	16	=	544
	29	at	14	=	406
	15	at	2	=	30

980 s. falſe Amount.
Should be — 936 true Amount.

s. s.
16 — 14 = 2) + 44 Error, too great.

Therefore take away 22 Gallons at 16 s. and add 22 Gallons at 14 s. and then 'tis evident you will decreaſe the total Value by 44 s. (= 2 s. × 22) without changing the total Quantity.

Thus.

	G.	G.	G.		s.		s.
Anſwer	34—22	=	12 at		16	=	192
	29+22	=	51 at		14	=	714
		And	15 at		2	=	30

Proof 78 × 12 = 936 the true Amount.

Or

Or thus.

s. s.	s. G. s.	
$\overline{14-2}$	$(=12)\times 2=24,$	take away 2 G. at 14*s.* and add 2 G. at 2*s.*
$\overline{16-14}$	$(=2)\times 10=20,$	take away 10 G. at 16*s.* and add 10 at 14*s.*
	Sum $44=$ the Excefs.	

Or thus.

s. s.	s. G. s.	G. s.
$\overline{16-2}$	$(=14)\times 2=28,$	take away 2 at 16, and add 2 at 2*s.*
$\overline{16-14}$	$(=2)\times 8=16,$	take away 8 at 16, and add 8 at 14*s.*
	Sum $44=$ the Excefs.	

And in like manner may many more Anfwers be found, upon this Affumption of the particular Quantities. Alfo, you may affume any other Numbers (whofe Total will make 78) for the particular Quantities, by which another Sett of Anfwers may be found, and fo on.

Thus.

	G.	s.	s.		G.	s.	s.
2d Affump.	50 at	16 =	800	Hence, the Anfwer is	54 at	16 =	864
	4 at	14 =	56		2 at	14 =	28
	24 at	2 =	48		22 at	2 =	44
true Quan.	78		— 904 fal. A.		78 ×	12 =	936 Pr.
			936 tr. A.				

s. s.

$\overline{14-2}=12\,)-32($ 2 add 2 at 14 and fub. 2 at 2

$\overline{16-14}=2\,)\;8($ 4 add 4 at 16 and fub. 4 at 14

ALLIGATION *applied to the Compoſition of Medicines.*

93.

Medicines (or Simples) in reſpect of their Qualities, are conſidered in ſome of theſe five Ways; *viz.* either as they are hot or cold, moiſt or dry, or temperate; ſo that all ſuch Medicines as are productive of Heat in our Bodies, are ſaid to be hot, and ſuch as are the Cauſe of Coldneſs are called cold, *&c.*

The Mean between the extreme Qualities of Heat and Coldneſs, or between Dryneſs and Moiſture, is called temperate, from which every extreme Quality differs in four Degrees; ſo that a Medicine (or Simple) is ſaid to be either temperate, hot, cold, moiſt or dry, in the firſt, ſecond, third, or fourth Degree, for which Purpoſe the following Index is contrived.

A 9	4	Qualities hot and dry.
8	3	
7	2	
6	1	
5	0	Temperate.
4	1	Qualities cold and moiſt.
3	2	
2	3	
B 1	4	
Exponents	Degrees.	

Hence,

Hence, if the Index (or Exponent) of any Simple or Medicine be 1, it is ſaid to be in the fourth Degree of Coldneſs or Moiſture.

If the Index be 9, it is ſaid to be in the 4th Degree of Heat or Dryneſs.

If the Index be $6\frac{1}{3}$, it is hot or dry in $1\frac{1}{3}$ Degree.

If the Index be $3\frac{1}{3}$, it is cold or moiſt in $1\frac{2}{3}$ Degree.

Hence, if we pleaſe we may omit the Uſe of the Index. For when the Index of any Simple exceeds 5, if we ſubtract 5 therefrom, the Remainder will expreſs what Degree of Heat or Dryneſs that Simple is in.

And when the Index is leſs than 5, ſubtract it from 5, the Remainder is the Degree of Coldneſs or Moiſture.

And if the Degree and Quality be given, the Index may be found; for if the Quality be hot or dry, then the given Degree being added to 5, the Sum is the correſponding Index.

If the Quality be cold or moiſt, then the given Degree being ſubtracted from 5, the Remainder is the Index.

And if the Index be 5, the Quality is temperate, and the Degree 0.

Note, *In all theſe Compoſitions, the Indexes are always uſed, in the ſame Manner as the Rates or Prices are in common Caſes of Alligation.*

Ex.

Ex. 1. An Apothecary desires to know what Quantities he must take of the following Simples, to make a Medicine, consisting of 27 Ounces, hot in the 3d Degree, *viz.* *A* hot in the 2d Degree; *B* hot in the 1st Degree; *C* hot in the 4th Degree; and *D* temperate?

	Indexes.		oz.	oz.	
Ind. 8	*A* 7	------	1 × 3 =	3 of *A*.	Ans.
	B 6	------	1 × 3 =	3 of *B*.	
	C 9	1+3+2 =	6 × 3 =	18 of *C*.	
	D 5	------	1 × 3 =	3 of *D*.	

9) 27

Therefore multiply by 3 as above.

Index.	Proof.
7 × 3 =	21
6 × 3 =	18
5 × 3 =	15
9 × 18 =	162

27) 216 (8 Index of 3 Deg.
0

Ex. 2. *A* is hot in 2°, *B* cold in 3°, *C* cold in 4°, *D* hot in 1°, and *E* temperate; 'tis requir'd to make a Medicine of these, cold in the 2d Degree?

	Indexes.		Ans. oz.		
Ind. 3	*A* 7	---	1 *A*	7	Products.
	B 2	---	4 *B*	8	
	C 1	3 + 2 =	5 *C*	5	
	D 6	---	2 *D*	12	
	E 5	---	2 *E*	10	

Proof 14) 42 (3 the Index of 2, as requir'd.
0

Ex.

Ex. 3. Four Ounces of *A* hot in 3°; 5 Ounces of *B* hot in 1°; 8 of *C* temperate; and 10 of *D* cold in 2°, being mixed together, 'tis requir'd to determine the Quality of the Medicine?

	oz.		Index.		
A	4	×	8	=	32
B	5	×	6	=	30
C	8	×	5	=	40
D	10	×	3	=	30
	27	)			132 (

$$\begin{array}{r} 5 \text{ temperate.} \\ -4\frac{8}{9} \text{ Index.} \\ \hline \end{array}$$

Answer $\frac{1}{9}$ Degree of Cold.

Note, *If the Index had been* $5\frac{8}{9}$, *the Medicine would then have been in* $\frac{8}{9}$ *Degree of Heat.*

Ex. 4. Suppose now it were requir'd to depress the Quality of the above Medicine to the 1st Degree of Coldness, by adding some Quantity of one Simple thereto.

To do this, you must throw in a larger Quantity of some Simple in a greater Degree of Coldness than the 1st Degree.

$$\begin{array}{ll} & \text{Ind.} \quad \text{oz.} \\ \begin{array}{c}\text{Ind.} \\ 4\end{array} & \left\{\begin{array}{c} 4\frac{8}{9} \\ 2 \end{array}\right) \begin{array}{c} 2 \\ \frac{8}{9} \end{array} \right\} \end{array}$$

Answer, to every two Ounces of the Medicine you must add $\frac{8}{9}$ Ounces (or to 1 Ounce add $\frac{4}{9}$) of some Simple cold in the 3°, therefore to 27 Ounces of the Medicine you must add 12 Ounces of a Simple cold in the 3°.

But this Case admits of several Answers, for you may add a proper Quantity of any Simple, whose Exponent is greater (when the Medicine must be hotter) or less (when the Medicine must be colder) than the Exponent of the Degree and Quality assign'd.

Ex. 5. A Medicine being made up of the following Simples, *viz.* 5 oz. of *A* hot in 3°, and dry in

2° ; 6 oz. of *B* cold in 4°, and moiſt in 1° ; 7 oz. of *C* cold in 1°, and moiſt in 3° ; 10 oz. of *D* temperate in reſpect of Dryneſs and Moiſture, and hot in 4° ; 12 oz. of *E* temperate in reſpect of Heat and Cold, and moiſt in 3° ; I deſire to know the Temperament of the Medicine?

Heat and Cold		Oz.		Ind.		
	A	5	×	8	=	40
	B	6	×	1	=	6
	C	7	×	4	=	28
	D	10	×	9	=	90
	E	12	×	5	=	60
		40	)			224
						$5\frac{3}{5}$

$5\frac{3}{5}$ Index of $\frac{3}{5}$ Heat.

Dryn. and Moiſt.						
	A	5	×	7	=	35
	B	6	×	4	=	24
	C	7	×	2	=	14
	D	10	×	5	=	50
	E	12	×	2	=	24
		40	)			147
						$3\frac{27}{40}$

$3\frac{27}{40}$ Ind. of $1\frac{13}{40}$ Moiſture.

Anſwer, the Medicine is in $\frac{3}{5}$ of the 1° of Heat, and in $1\frac{13}{40}$ Degree of Moiſture.

FEL-

FELLOWSHIP.

94.

When the particular Stocks, and total Gain are given, to find the particular Gains.

Rule 1. Find what Fraction the total Gain is of the total Stock, and take a like Fraction of each Man's Stock for his Share of the Gain.

Or divide the total Gain by the total Stock, this Quote multiply'd by any Man's Stock gives his Gain.

Or divide the total Stock by the total Gain; then any Man's Stock divided by this Quote, gives his Gain.

Rule 2. Find what Fraction (proper or improper) any Man's Stock is of the total Stock; and take a like Fraction of the total Gain, for his Share thereof.

Rule 3. As any Man's Stock to his Gain, so is any other Man's Stock to his Gain.

Hence,

Whatever Fraction or Multiple any Man's Stock is of his Gain, the same Fraction or Multiple is any other Man's Stock of his Gain.

Or whatever Fraction any Man's Gain is of his Stock, the same Fraction is each Man's Gain of his Stock.

There-

Therefore,

If you divide any Man's Gain by his Stock, then this Quote multiply'd by any other Man's Stock, gives his Gain.

Or any Man's Stock being divided by his Gain, if you divide any other Man's Stock by this Quote, the Quotient will be his Gain.

Rule 4. As the total prime Stock, to the total increafed Stock; fo is any Man's prime Stock, to his increafed Stock.

95.

CONTRACTIONS.

In fingle Fellowfhip, you may divide the feveral Stocks by any common Meafure, and then ufe thefe Quotients inftead of the Stocks.

Ex. 1. *A* puts in 40 *l.* *B* 60 *l.* *C* 100 *l.* they gain 44 *l.* 16 *s.* 6 *d.* what is each Man's Share of the Gain?

$$\div 2 \left\{ \begin{array}{c|c|l} 4 & 0 & 2\ A. \\ 6 & 0 & 3\ B. \\ 10 & 0 & 5\ C. \end{array} \right.$$

$$\begin{array}{r} l. \\ 10\ )\ 44,825 \\ \hline \end{array}$$

$$\text{Common Multiplicand} = \begin{array}{r} 4,4825 \\ \times 2 \\ \hline \end{array}$$

$$\text{Anfwer, } A\text{'s Gain} = 8,9650\ |$$

$$\text{Common Multiplic.} = \begin{array}{r} l. \\ 4,4825 \\ \times 3 \\ \hline \end{array} \qquad \begin{array}{r} l. \\ 4,4825 \\ \times 5 \\ \hline \end{array}$$

$$\text{Anfwer, } B\text{'s Gain} = 13,4475\ | \quad C\text{'s} = 22,4125\ |$$

96.

But this Direction may also be applied, when the common Divisor is not a common Measure to the Stocks.

Ex. 2. *A* puts in 72 *l.* *B* 36 *l.* and *C* 40 *l.* they gain 18 *l.* 10 *s.* requir'd each Man's Gain?

$$\div 36 \left\{ \begin{array}{r|l} 72 & 2 \\ 36 & 1 \\ 40 & 1\frac{1}{9} \end{array} \right.$$

$$\begin{array}{rl} \text{—} & 18,5 \\ 4\frac{1}{9} & \times 9 \\ \hline 37 &)\,166,5 \end{array}$$

$$\begin{array}{ccc} 4,5 \text{———} & 4,5 \text{———} & 4,5 \\ \times 2 & \times 1 & 9)\times 5 \end{array}$$

Answer, *A*'s $= 9,0$ | *B*'s $= 4,5$ | *C*'s $= 5,0$ |

97.

Double Fellowship may also be contracted in like manner as single Fellowship, by proceeding with the Stocks, or Times, or their Products, as with the Stocks in single Fellowship.

Ex. *A* puts in 60 *l.* for 1 Year, *B* 48 *l.* for 20 Months, and *C* 36 *l.* for 4 Years, they gain 576 *l.* 13 *s.* 3 *d.* what is each Man's Gain?

$$\begin{array}{l|l|l} \div 12 \;\; \div 4 & \text{R}^{d}. \quad * & \text{R}^{d}. * \\ 60\text{—}12 & 5\times\;3 = 15 & 3\; A \\ 48\text{—}20 & 4\times\;5 = 20 & 4\; B \\ 36\text{—}48 & 3\times 12 = 36 & 7\frac{1}{5}\, C \end{array}$$

$$\begin{array}{rl} \text{—} & 576,6625 \\ 14\frac{1}{5} & \times 5 \\ \hline 71 &)\,2883,3125\,(\,40,61 \text{ C. M.} \end{array}$$

M

Then

Then

$$\begin{array}{r} 40,61 \\ \times 3 \\ \hline A\text{'s} = 121,83 \end{array} \quad \begin{array}{r} 40,61 \\ \times 4 \\ \hline B\text{'s} = 162,44 \end{array} \quad \begin{array}{r} 40,61 \\ \times 7\frac{1}{5} \\ \hline 28427 \\ 8122 \\ \hline C\text{'s} = 292,392 \end{array}$$

98.

In Fellowſhip there are four grand Caſes, which may be ſubdivided into ſeveral inferior Caſes; I ſhall therefore (for the Satisfaction of the Curious) give theſe four Caſes, with their Subdiviſions (or inferior Caſes) and Rules for their Solution, but ſhall leave the Application of theſe Rules, for the Learner's Exerciſe, as they are Matters of Curioſity rather than of Utility.

GRAND CASES.

1. When the Times are equal,
   The Gains are directly as the Stocks.

2. When the Stocks are equal,
   The Gains are directly as the Times.

3. When the Gains are equal,
   The Stocks are inverſely as the Times, and the Times inverſely as the Stocks.

4. When the Stocks and Times are unequal,
   The Gains are in the compound Ratio of the Stocks and Times.

GRAND

GRAND CASE I.

1. *Given the particular Stocks, and total Gain (or 1 Gain, or Sum of 2 Gains) to find the Gains.*

RULE.

As total Stock : to total Gain :: ſo is each Stock : to its Gain.

2. *Given the particular Gains, and total Stock (or 1 Stock, or Sum of 2 Stocks) to find the Stocks.*

RULE.

As total Gain : total Stock :: each Gain : its Stock.

3. *Given the increaſed Stocks, and total Gain (or 1 Gain, or Sum of 2 Gains) to find the Gains.*

RULE.

As total increaſed Stock : total Gain :: each increaſed Stock : its Gain.

4. *Given the Stocks, and Difference of 2 Gains, to find the Gains.*

RULE.

As Dif. of 2 Stocks : Dif. of their Gains :: either Stock : its Gain.

5. *Given the Gains, and Difference of 2 Stocks, to find the Stocks.*

RULE.

As Dif. of 2 Gains : Dif. of their Stocks :: either Gain : its Stock.

GRAND CASE 2.

1. *Given the Times, and total Gain, to find the Gains.*

RULE.

As Sum of the Times : Sum of the Gains :: each Time : its Gains.

2 *Given the Times, and Difference of 2 Gains, to find the Gains.*

RULE.

As Dif. of 2 Times : Dif. of their Gains :: either Time : its Gain.

3. *Given the Gains, and Difference of 2 Times, to find the Times.*

RULE.

As Dif. of 2 Gains : Dif. of their Times :: either Gain : its Time.

4. *Given the Gains, and Sum of the Times (or Sum of 2 Times) to find the Times.*

RULE.

As total Gain : Total of the Times :: either Gain : its Time.

GRAND CASE 3.

1. *Given the Times, and Sum of 2 Stocks, to find the Stocks.*

RULE.

As Sum of 2 Times : Sum of their Stocks :: either Man's Time : the other Man's Stock.

2. *Given the Times, and Difference of 2 Stocks, to find the Stocks.*

RULE.

As Dif. of 2 Times : Dif. of their Stocks :: either Man's Time : the other Man's Stock.

3. *Given the Stocks, and Sum of 2 Times, to find the Times.*

RULE.

As the Sum of 2 Stocks : Sum of 2 Times :: either Man's Stock : to the other Man's Time.

4. *Given the Stocks, and Difference of 2 Times, to find the Times.*

RULE.

Dif. of 2 Stocks : Dif. of their Times :: either Man's Stock : to the other Man's Time.

5. *Given the Sum of the Products of the Stocks and Times, and the Times, to find the Stocks (or the Stocks, to find the Times.)*

RULE.

Divide the Sum of the Products by the Number of the Partners, the Quote is each Man's Product; which divided by any Man's Time, the Quote is his Stock (or divided by his Stock, the Quote is his Time.)

GRAND CASE 4.

1. *Given the Stocks, Times, and total Gain, to find the Gains.*

RULE.

This being a common Caſe, is ſolved by the common Rules.

2. *Given the Stocks, Gains, and Sum of the Times, to find the Times.*

RULE.

Make each Man's Gain a Numerator to his Stock (taken as Denominator.)

Then,

As the Sum of theſe Fractions, to the Sum of the Times; ſo is each Fraction, to its correſponding (or included) Time.

Or thus. Rule 2.

Multiply each Gain by the Product of all the Stocks, except its own.

Then,

As the Sum of theſe Products, to the Sum of the Times; ſo is each Product, to its involved Time.

3. *Given the Times, Gains, and total Stock, to find the Stocks.*

RULE.

Multiply each Gain by the Product of all the Times, except its own.

Then,

As the Sum of these Products, to the total Stock; so is each Product to its involved Stock.

4. *Given the Gains, the Total of the Products, and the Times, to find the Stocks (or the Stocks, to find the Times.)*

RULE.

As the total Gain, to the Total of the Products; so is each Gain, to its Product.

Then,

Any Product divided by its Time, quotes its Stock (or divided by its Stock, quotes its Time.)

5. *Given the Gains, Stocks, and one Time, to find the other Times.*

Or,

Given the Gains, the Times, and one Stock, to find the other Stocks.

RULE.

As any Man's Gain (or Stock) to his Product; so is any other Man's Gain (or Stock) to his Product; and any Man's Product, divided by his Stock, quotes his Time; or divided by his Time, quotes his Stock.

Note, *In the second Recreation of the first Volume, you will find Questions to exercise most of these Cases.*

CONCLUSION.

I ſhall conclude this Work with doing juſtice to thoſe Gentlemen from whom I have borrowed any thing material, and a ſhort Explication of the few Characters uſed in the Book, *&c.* To begin then, Articles 8, 10, 12, 26, 30, are taken from Mr. *Malcolm*'s Arithmetic. — Articles 4, 16, 25, 32, 35 are taken from the *Royal Gauger*, &c. though by them applied to other Purpoſes.—Art. 24, 45, 60, 61, 67, are taken from Mr. *Hodgkin*'s, and the Sieur *Monieur Declarecombe*'s Arithmetics.—Art. 46, 50, are taken from Mr. *Hill*'s Arithmetic. — Art. 34, 53, 59, 64, 90, 91, and Rule 1, of Art. 57, are taken from *Wingate*'s Arithmetic by *Kerſey*, *Shelley*, and *Dodſon*. — Art. 84, and 92, are taken from Mr. *Fletcher*'s Tranſlation of an anonymous *French* Author's Arithmetic. However, although what I have here aſcribed to theſe Gentlemen are theirs in Subſtance, yet I have taken the Liberty to alter the Expreſſion of their Rules, where I ſaw Occaſion, and where they have ſometimes given particular Rules (or Examples) I have given general ones, and have taken the trouble to compoſe all the Queſtions: And to ſatisfy the Reader at one View, all that are marked with an Aſteriſk in the Table of Contents, are borrowed.

As ſome very conciſe Methods of multiplying and dividing by any Line of 9's, which will be found very uſeful in the Management of circulating Decimals, have occurred to me ſince the Book has been printed off, I ſhall take the Liberty of inſerting them here.

99.

To give the Product of any Number by any Line of 9's, writing down only the Anſwer.

Caſe 1. *When the Number of 9's is leſs than the Number of Places in the other Factor.*

Rule. Draw a Vinculum over as many Places to the right in your Multiplicand, as there are 9's in the Multiplier; then put down the Exceſs of 9 above every Figure under the Vinculum, except that in the Unit's Place, the Difference between which and 10 muſt be put down; after which add 1 to the Figures out of the Vinculum, and ſubtract the Sum from the given Multiplicand, putting down the Remainders (as found) to the left of the former Figures put down; this complete Remainder is the Product ſought.

Ex. Multiply $12\overline{34567'89}$ by 9999999.
Anſwer 1234567766543211 Product ſought.

Having put down the Reſidues of the Figures under the Vinculum, I add 1 to the remaining Figures (out of the Vinculum) and ſubtract the Sum (13) from 89, the Remainder (77) I put down to the left of the former Differences; then to the left of theſe, I put down all the remaining Figures of the Multiplicand.

Caſe 2. *When the Number of Places in the Multiplicand does not exceed the Number of 9's in the Multiplier.*

Rule. Put down as many 9's as the Number of Places in the given 9's exceeds the Number of Places in the other Factor (or Multiplicand); then to

to the right of these 9's, put down the Excess of 9 above every Figure of the Multiplicand (in the same Order) except the right-hand Figure, the Difference betwixt which and 10 must be put down; then to the left of the 9's put down the Multiplicand less 1. Consequently, if the Number of Places in both Factors are equal, you will not have any of the 9's of the Multiplier to put down.

Ex. Multiply 38703 by 99999999.
Answer 3870299961297 Product sought.

Note, *Case* 1 *is deduced from Art.* 8, *which is Mr.* Malcolm's.

100.

To multiply by any Number, the Sum of every two Figures, of which, taken as many Places asunder as there are Places more 1 *in half the Number of Figures in the Multiplier, make* 9.

Rule. Multiply the given Multiplicand by half as many 9's as there are Places in the given Multiplier (by Case 1. Art. 99.) then multiply this Result by the Figures plus 1, to the left of the Center of the given Multiplier, this Product will be the Product sought.

Ex. Multiply $427385\overline{976}$ by 253'746

426958590024 Product by 999
× 254

1707834360096
2134792950120
853917180048

Answer 108447481866096 Product.

That

That the given Multiplier is of the required Order, is evident, for 6 and 3 is 9, 4 and 5 is 9, 7 and 2 is 9, and every two added Figures are four Places asunder inclusively.

But this Rule may be extended to any Multiplier whatever, tho' not with equal Advantage in all Cases.

Thus, having found the Product by the nearest Multiplier of the foregoing Order; then to or from this Product add or subtract the Product of your given Multiplicand by the Difference betwixt your given and assumed Multipliers, according as the given Multiplier exceeds or is less than the assumed.

Ex. Multiply $5678\overline{2394}$ by $7698'2313$

$$\begin{array}{rr}
5677671576\overline{06} & -\ 2301 \\
\hline
 & +\ 12 \\
56208948602994 & \\
3406602945636 & \\
3974370083242 & \\
\hline
\end{array}$$

Answer 4371240027797322 Product.

Note, *When there are any Number of* 9's *in the Center of your given Multiplier, the same Rule (as first given) will hold, if you consider the* 9's *as excluded, and take the remaining Figures as your Multiplier; only observe to multiply by as many more* 9's *(or draw the Vinculum over as many more Places) than in the former Case, as there are* 9's *in the Center of your given Multiplier.*

Ex. Multiply $4273\overline{85976}$ by $253\overline{99}746.$

$$\begin{array}{rr}
4273817021402\overline{4} & +1 \\
\times\ 254 & \overline{254} \\
\hline
17095268085609\overline{6} & \\
21369085107012\overline{0} & \\
8547634042804\overline{8} & \\
\hline
\end{array}$$

Answer 10855495234362096

101.

To determine the Quote of any Number divided by any Number of 9's, by Inspection.

Rule. Draw a Vinculum over as many Places to the right in your Dividend, as there are in your Divisor; then draw another Vinculum over as many Places, and one more, to the left; which done, if to the Figures under this Vinculum you add the first Figure of the Dividend, the Sum, excluding the first Figure thereof, will be so many Figures of the Quote, in the same Order, placing the first Figure thereof under the right-hand Figure of the left-hand Vinculum.—Then add the first Quote-figure to that Figure of the Dividend which stands directly over it; (observing to take in the Carriage resulting from a mental Addition of those to the right thereof;) and put down what is under or over ten to the right of the former Quote-figures; and thus proceed with the next Pair to the right, and so on, till you have got a Quote-figure under the Unit's Place of the Divisor; these Figures, thus found, make your complete Quote: and for your Remainder, take the Sum of all the Figures (in both Lines) under the right-hand Vinculum, rejecting what falls out of the Vinculum in the Addition.

Ex. 1. Divide $\overline{78365}\overline{98241}$ by 9999, giving only the Quote and Remainder. 783738 Quote.

1979 Remainder.

Note, *When all the Figures in the Remainders are 9's, you must add one to the Quote found by the Rule, and the Remainder will be* o.

Ex. 2. Divide 49989977 by 999.
50040 Quote.
1017 Remainder.

Ex.

Ex. 1. explained. The 7 being added to 78365, the Sum is 7837 (rejecting the first Figure 2 as *per* Rule) which make the four first Figures of the Quote; then from the Sum of 8 and 9 there is 1 to carry, which added to the Sum of 7 and 5, makes 13, that is 3 to put down; then from the Sum of 3 and 8 there is 1 to carry, which added to the Sum of 8 and 9 makes 18, that is 8 to put down, which completes the Quote.—The Sum of all the Figures under the right-hand Vinculum is 11979, out of which excluding the left-hand Figure (because it falls out of the Vinculum) the remaining Figures 1979 is the exact Remainder.

Ex. 2. The Sum under the left-hand Vinculum (rejecting the first Figure) is 500, then supposing the 5 and 8 added, gives 3 for the fourth Figure of the Quote; but this added mentally to 997 gives 1 to carry to the Sum of 5 and 8, which makes the fourth Figure of the Quote 4, and not 3.

This will be found very useful in determining the finite Values of circulating Decimals.

102.

Having considered the regular Order of the Process at Art. 13, for multiplying by any Line of 1's, the following Method occur'd to me, which is certainly much easier and more expeditious than any other Method yet published on that Particular.

To multiply by any Line of 1's, in the easiest Manner.

Rule 1. Put down the first Figure of the Multiplicand for the first Figure of the Product; then add the second Figure of the Multiplicand to the first Product-figure, and the third of the Multiplicand to the second of the Product; and so on till you have added as many Figures of the Multiplicand (including the first) as there are 1's in the Multiplier, as in common Addition, carrying for the Tens, and putting down the rest.

2.

2. Then take the Difference betwixt the next left-hand Figure of the Multiplicand (increased by 1, if the Sum at the last Step exceeded 9) and the first of the Multiplicand; which Difference add to the last Product-figure if the left-hand Figure exceeds, otherwise subtract (adding 10 to the Product-figure if needful for Subtraction); but observe, that the Carriage for Addition must be added to the left-hand Figure, and the Carriage for Subtraction must be subtracted, before you seek the Difference betwixt the extreme Figures of that Step; and thus proceed, leaving out one Figure to the right, and taking in one to the left at every Step, and then adding or subtracting the Difference of the two extreme Figures of every Step, as before, till you have taken in the Figure in the highest Place of the Multiplicand. Then proceed thus:

3. Having increased that Figure of the Multiplicand, which is in the next higher Place to the extreme right-hand Figure of the last Step, by 1. if you had 1 to carry for Subtraction from the last Step, or decreased it by 1 if you had 1 to carry for Addition, subtract the Sum or Difference from the last Product-figure, (adding 10 thereto if needful, and then add 1 to the next Subtractor) and so proceed, still subtracting the next higher Figure (with the Carriage) of your Multiplicand from the last Product-figure, till you have subtracted that Figure of the Multiplicand which is next to the highest.

Note, *When the Figure in the highest Place of the Multiplicand is* 9, *and there would have been* 1 *to carry thereto by common Addition, you must prefix* 1 *to the left of the Product found by the Rule*, *as* per *Ex.* 2.

+1

Ex. 1. Multiply 45678235 by 111.

Answer 5070284085 Product.

EXPLANATION.

$\overset{1}{5}$ | $3+5=\overset{1}{8}$ | $2+8=10$ | $\overline{1+8}-5=\overset{1}{4}$ | $\overline{7}-3=4$, and $4+4=\overset{1}{8}$ | $6-2=4$, and $4+8=\overset{1}{12}$ | $1+5=6$, and $8-6=2$, then $2-2=\overset{1}{0}$ | $7-4=3$, and $10-3=\overset{1}{7}$ | $1+6=7$, and $7-7=\overset{1}{0}$ | $10-5=\overset{1}{5}$. |

Note, *The Product-figures are dashed in the Explanation.*

Ex. 2. Multiply 92174569$\overset{-1}{8}$ by 1111.
1024059470478.

Note, *Art.* 24. *may be applied to Weight, or any different Denominations, to be multiplied by any whole Number.*

	Ct.	q.	lb.
Ex. Multiply	42	3	24 by 586
			×6
	257	3	4
	3437	0	16
	21482	0	16
Answer	25177	0	8

~~14~~	~~11~~
	~~84~~~~6~~
28) ~~1040~~	28) ~~11000~~
~~6~~8	~~4~~28
2	3

Hence any Question of the Rule of Three may be wrought by this Method, without reducing the middle Term. The same may applied with Advantage in Mensuration.

Explanation of the Characters used in this Volume.

Signs.

— Minus (or less) is the Sign of Subtraction, and denotes that the Number before which this Sign is prefixed is a Subtractor; hence $100-98$ (page 2.) is read 100 less 98, signifying their Difference.

+ Plus (or more) is the Sign of Addition, and denotes that the Number before which it is prefixed is to be added; hence $6+8$ (p. 14. l. 27.) is read 6 more 8, signifying their Sum.

× This is the Sign of Multiplication; hence 5×4 (p. 16. l. 3.) is read 5 multiplied by 4, and denotes the Product.

÷ This is the Sign of Division, shewing that the Number to the left of the Sign is to be divided by that to the right thereof, and denotes the Quote.

— or — a Vinculum; when a Line is drawn over two or more Numbers, thus $\overline{3+7}\times4$ it is called a Vinculum, and denotes that all the Numbers under the Line (as connected) must be multiplied or divided, *&c.* by the next to the right, according as the connecting Sign denotes; so $\overline{3+7}\times4$ denotes that the Sum of 3 and 7 must be multiplied by 4; whereas had they been wrote down without the Vinculum, thus $3+7\times4$, it would have signified that 7 must have been multiplied by 4, and that Product added to 3.

= Equal, this is the Sign of Equality, and denotes that the Numbers (or Quantities) on both Sides of the Sign are equal; so $\overline{1\times4+2}+5\times5=31$ denotes that if 1 be multiplied by 4, and that Product added to 2, and this Sum added to 5 times 5, the last Sum will be equal to 31.

$3:4::6:8$
Read thus, as 3 to 4, so is 6 to 8.

F I N I S.